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ACROSS RUSSIAN LAPLAND IN SEARCH OF BIRDS.

By HARRY F. WITHERBY, F.Z.S., M.B.O.U.

I.—VARDOE AND THE WHITE SEA.

THERE are some people, one might almost term them a fraternity, for whom a wild and desolate land has a strange fascination. A barren and forsaken spot, the very aspect of which casts a gloom over the ordinary mortal, is for them a paradise. There they are thrilled with joy, an overwhelming feeling of freedom takes possession of them, and a desire to race over the country and explore it to the horizon seizes upon them like a mania. For such the regions to the north of the arctic circle have many attractions, and when once the wealth of wildness and solitude to be found there have been tasted by one infected with this craze then ever afterwards the North Pole will draw him as surely as it attracts the needle of a compass.

Ornithologists, and English ornithologists especially, whether worshippers of solitude or not, seem to be particularly devoted to those northern regions where in summer the sun reigns supreme. The northern parts of Norway, Lapland, and Siberia have been so thoroughly explored by them that it was only after a long search that my friend Mr. A. E. Hamerton and myself could fix on a route in those regions which had not been visited by some brother craftsman. We agreed at length to journey to Archangel by sea, and then proceeding to the southern end of the Kola peninsula or Russian Lapland to walk across to the Arctic Ocean along the route taken by Messrs. Edward Rae and H. P. Brandreth.* As far as we could discover this country had not been traversed by any other Englishmen, and although Russian ornithologists had worked there in the winter when the snow makes travelling easy, very little was known of the birds inhabiting the interior of the peninsula in summer.

Starting from home early in June, 1899, and crossing the North Sea, whose unkindly nature is well known to all who visit Norway, we soon arrived at Christiania. An eighteen hours' railway journey thence brought us to Trondhjem where we embarked on the good ship "Sigurd Jarl" bound for Vardoe. It was a pleasant voyage in and out amongst the islands, and through rocky channels where the snow-capped hills rise sheer out of the sea. We passed the Lofoden Islands, devoted to fisheries, and Tromsoe, and arrived at Hammerfest, where the streets were still coated with ice and bordered with heaps of dirty snow.

From Hammerfest a few hours of rough water round the North Cape brought us to Vardoe. Here we learnt that the "oldest inhabitant" could not remember so late a season, and that the Russian boat that was to take us to Archangel had not yet broken through the ice in the White Sea.

However, a few days in Vardoe were well spent. The town and the small island upon which it stands are entirely given up to cod fish. Vardoe is built along the edge of its harbour, and the harbour is fringed with small quays, which are at all times scenes of the greatest activity, day and night in this latitude being scarcely distinguishable. Open boats, shaped exactly like the old viking ships, rowed or sailed by hardy Norsemen, are continually coming into the harbour laden with cod and red mullet, while others are going out to the fishing grounds away in the Arctic Ocean, often

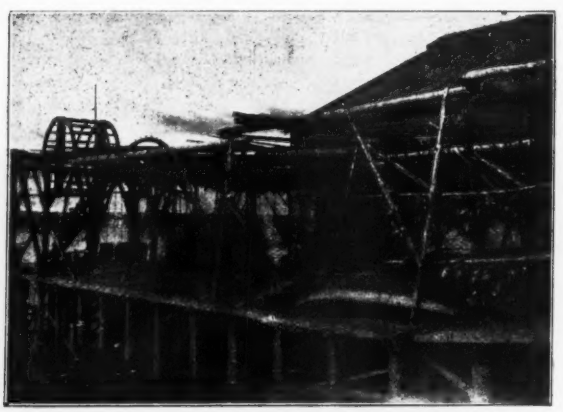
A Boat-load of Cod on the Quay at Vardoe.

10 or 15 miles from land. The quays are always full of fish, which are hauled up from the boats in baskets

* *See* "The White Sea Peninsula," by Edward Rae, F.R.G.S. (Murray), 1881.

by means of ropes coiled round large wheels. On the quays men, women, and children are hard at work sorting, gutting, and salting fish, extracting the liver oil, tying the fish in pairs tail to tail, threading the cods' heads on lines, baiting the hooks and coiling the lines into baskets ready for the fishermen. The fish and the heads are hung up to dry on laths fixed to poles all over the island, whilst discarded fish and those dropped accidentally lie about everywhere on the quays and in the streets and are eaten with avidity by cats, goats, and cows. Yet for all this wealth of fish you cannot get a fresh cod to eat, as they are all salted and dried and sent to Russia and Spain, while the heads are dried and used for manure. But so pure and fresh is the air that, notwithstanding all the mass of corruption on the island, there is very little smell, and even the decomposing cods' heads scarcely taint the fresh northern breezes.

The drying grounds proved most interesting to us, especially where there hung rows and rows of heads, as the maggots in these attracted numbers of birds. Snow buntings† in their beautiful velvety black and snow white summer plumage were numerous, while elegant shore larks,‡ with their handsome black ear tufts, evidently found the cods' heads good hunting



A Quay at Vardoe with Cods' Heads in Strings.

grounds, and their pretty little songs testified to their contentedness. Then in the marshy ground under the drying fish we found Temminck stints,§ which rose fluttering into the air calling rapidly tzi-tzi-tzi. Round the coast on the sea-washed rocks were purple sandpipers‖ in all the glory of their summer sheen. In the sea were numerous eider ducks,¶ the drakes in black and white and sea-green, cooing like stock doves, and flirting with their sombre coloured mates. Black guillemots** were in swarms, and their soft mellow whistles floated peacefully over the cold water, while gulls of many sorts flew backwards and forwards overhead. On the mainland, which we visited one day, or was it night, we found still more birds. The country was white with snow, but here and there on patches of green where the snow had melted, and on the shore we found the birds. Dotterels,†† with all their well-known silliness, allowed us to approach within a few yards, but sanderlings‡‡ and little stints,§§ in their rich brown breeding plumage, were more wary. Lapland buntings‖‖ were building their nests on the dryest parts available of the wet ground uncovered by snow, and the male birds often rose into the air singing, like pipits, on the wing, soft little piping songs. Then we saw three Arctic skuas,¶¶ those robber gulls which chase their hard-working cousins, and, making them disgorge their honestly earned prey, swoop down and catch it ere it reaches the surface of the water. As is well known these birds vary greatly in colouring from sooty black all over to greyish white on the under parts. Of the three we saw two were dark and one light. We approached them, and while one bird flew away the other two swooped down near to us several times, and then settled on the ground at some distance, and spreading out their wings, quivered them and uttered a plaintive meauw. Knowing by this that they must have eggs, we searched about, and on a strip of ground from which the wind had swept the snow, we found a small hollow lined with moss and lichen, and containing two dark brown eggs. The third bird, which had flown away, we noticed was being chased and buffeted continually by the other two, and we could not understand what was his share in this domestic scene. Some weeks afterwards in Lapland I found a similar trio, and managed to shoot the third bird, which in this case also appeared to be "one too many," and was continually chased and ill used by the other two. My shot only winged it, and the bird was floating down to the ground when the other two meanly attacked it and knocked it over, so that it fell in the middle of a very soft bog. The bog appeared to be of an unfathomable depth, but I was determined to get the bird and clear up the mystery, so I took off my coat and in a couple of hours managed by great exertions to pull up by the roots eight fair sized birch trees and build a bridge over the bog to the bird. It was a dark coloured specimen, but the rufous edgings to many of the feathers on the back proved it to be an immature bird evidently hatched the year before. So that presumably in two cases a pair of adult birds was attended by a single youngster whose presence evidently interfered with domestic bliss.

From Vardoe we journeyed on by a small coasting steamer to a place called Petschenga, where we were to meet the Archangel boat. The Arctic Sea was wonderfully calm, and we were delighted to see some way from land a flock of those charming little birds the red-necked phalaropes,*** floating like corks upon the water. They were as tame as farmyard chickens, and were so buoyant that on alighting on the water they appeared scarcely to touch it, and the sea was so still and glassy that one might have thought they were resting upon ice rather than water. At Petschenga the snow was waist deep and very soft, so that we found we could not explore the country far. We got along well on the top of the snow for some distance, when suddenly the crust gave way and we were floundering about up to our armpits in wet and clinging snow. Near the water, however, there were places bare of snow, but very wet. These spots were full of birds, several of which were building nests, seeming determined to take full advantage of the

† *Plectrophenax nivalis.* ‡ *Otocorys alpestris.*
§ *Tringa temmincki.* ‖ *Tringa striata.*
¶ *Somateria mollissima.* ** *Uria grylle.*
†† *Eudromias morinellus.*

‡‡ *Calidris arenaria.* §§ *Tringa minuta.*
‖‖ *Calcarius lapponicus.* ¶¶ *Stercorarius crepidatus,*
*** *Phalaropus hyperboreus,*

short northern summer. We watched a pair of little stints, those tiny snipe-like birds, love-making with twitterings, and fluttering of wings within a few yards of us, while the male red-throated pipits††† were singing encouragingly to their mates who were hard at work building nests on little mounds raised above the general slush.

When at length we boarded the Russian cargo boat which was to take us to Archangel we found our fellow passengers were mostly rough unkempt Russian peasants, with tawny beards and long hair. They were clothed in long sheepskin coats, high black boots, and round fur caps, and they appeared very hardy but very dirty. The steamer stopped every few hours at the small fishing stations along the Murman coast to land a few stores, and to take on board barrels of fish, bundles of porpoise skins, and other fishy cargo. The landing and shipping of this cargo, which was done by small boats, invariably caused an immense excitement. Each boat tried its best to get to the side of the steamer first, and the gesticulations, shouts, curses, and general hubbub raised by the process might well have been products of the fiery south or east rather than of the grave and solemn north. We were glad when all the villages were past, and we left the coast and entered the White Sea.

We went to sleep that night in high hopes that on waking we should be nearing Archangel. But when we awoke the steamer was laid to in a thick fog. In a few hours the fog lifted, and revealed a sea covered with ice—white and dazzling—as far as the eye could see. A man was sent aloft, but no channel could be found so we slowly skirted the sea of ice. But almost before we could take in the scene, the merciless fog dropped down again like a curtain and shut out everything from sight. For five days we lay surrounded by ice and fog, scarcely moving at all. At first the captain, hoping for the best, pushed his boat into the ice, and for hours we struggled with the floes. The steamer was sharp in the bows and had twin screws, both bad faults for an ice boat. The bows when driven into a floe got jambed, and the boat had to be backed out, while the screws, being quite unprotected, were in continual danger of being broken by a collision with the ice, which was very thick and often reached far below the keel of the ship. Consequently men had to be stationed fore and aft with long fir poles to push off the floes, while the captain ran from side to side of the bridge signalling every moment to the engineers to stop one screw or the other as it was in danger of fouling the ice. The crew worked like slaves for hours, but the only result of their labours was to fix the ship more firmly than ever in the ice. Then the fog lifted for a brief half-hour and showed us to be in an uncomfortable position which might result in the ship being nipped. By dint of hard work she was turned round, and a day of toil brought us once more out of the ice. The captain had been twenty-four hours on the bridge working hard in a freezing fog, and the crew were worn out, so for the next few days we hove to and waited. The monotony was broken only by the melancholy screech of syrens, for there were fourteen other boats round about us, all waiting for the fog to clear and the ice to shift. A little excitement was caused one day when, judging by the quality of the food, we appeared to be running short of provisions, and on another when we were told that our coal was giving out. However, a few broad hints to the steward brought forth better food, and a begging tour to the neighbouring ships resulted in one coming alongside and filling our bunkers with coal.

At last the fog lifted, and making a bold move our bright little captain turned his boat round and steamed right back to the coast. The set of the tide had made a broad lane of clear water between the land and the ice, and down this we steamed full speed ahead, slowing up now and then to thread our way through some detached floes or to force a passage through a narrow belt of ice. Before the tide changed and brought down the ice again to the shore we were through, and steaming gaily for Archangel. While we raced the tide with cheerful hearts our eyes were treated to the most glorious spectacle. The fog had completely cleared, and the sky was cloudless. For an hour—between eleven o'clock and midnight—the sun just skirted the horizon as though uncertain whether to go below or not. The heat went out of it, and its brilliancy faded, but the effect of its combined setting and rising was exquisite. The horizon shone like gold, and stretching from it lay the snow-covered ice, blushed with a delicate pink, and with here and there on its surface a pool shining like an emerald, while at our feet the dark, deep blue of the open water served as a strong and fitting contrast to the delicious delicacy of colouring beyond. As the sun rose higher the colours faded and we went below cold but happy. While we slept we crossed the arctic circle once more, and when we awoke some hours later the air was balmy, and the delicious scent of pines drifted through the cabin port hole. We were in the delta of the Dwina, and steering up one of its narrow channels we soon arrived at Solombala, the port of Archangel.

††† *Anthus cervinus.*

VEGETABLE MIMICRY AND HOMOMORPHISM.—I.

By Rev. ALEX. S. WILSON, M.A., B.SC.

BESIDES the family likeness and similarity of structure characteristic of closely allied organisms, other resemblances included under the terms Mimicry and Homomorphism, are observed among living things which cannot be referred to a common ancestry since they are presented by plants and animals whose affinities are more or less remote. If the resemblance confers any benefit on either species it is spoken of as a case of Mimicry, but if it results from the operation of general laws and is not directly advantageous, the likeness is described as Homomorphic. It is not always possible to draw a sharp line between the two, and homomorphism not improbably represents one stage in the development of mimetic species.

Both kinds of resemblance are common in the animal kingdom. The most perfect examples of mimicry occur among butterflies, particularly among the Pieridæ of South America, where it was first observed by Mr. Bates. Most members of this family resemble the ordinary cabbage-butterfly, but it includes species of *Leptalis*, which imitate the Heliconidæ in the shape and bright parti-coloured markings of their wings. The latter have a nauseous taste and are not molested by birds. So exact is the imitation that even experienced entomologists have been deceived. In the Malayan Archipelago Mr. A. R. Wallace found species of *Papilio* mimicking certain other families which have an offensive odour and are, like the Heliconidæ, distasteful to birds.

The curious walking-leaves and stick insects belong to the Phasmidæ, a family allied to the locusts and grass-

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hoppers. To such a degree has the imitation been carried in Ceroxylus that the insect looks exactly like a twig overgrown with moss. By reason of its resemblance

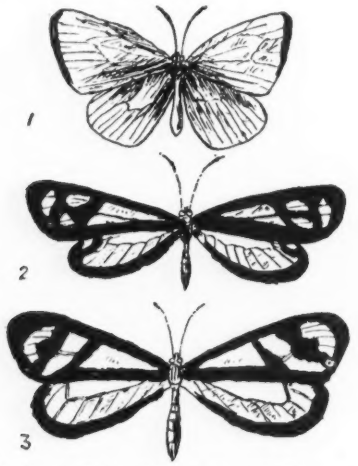

Fig. 1.—Mimicry in Butterflies. 1. Leptalis Type. 2. Leptalis mimicking. 3. Ithomia, model.

to a bee the fly *Volucella* can enter the hive and leave its eggs without exciting the suspicions of the bees. Certain clear-winged moths are also liable to be mistaken for bees and hornets.

Protective colouring is very common in the plumage of birds, a green woodpecker, for instance, is not easily distinguished amid the surrounding moss and foliage. Cuckoos are often mistaken for hawks, which they much resemble both in appearance and flight. Dun-coloured, tawny, striped and spotted animals are difficult to detect amid their native haunts. The fur of a number like the arctic hare and fox becomes white in winter, harmonizing with the snow-covered ground. Most of the autumnal Lepidoptera are brown or golden, while the winter species usually assume a grey or silvery garb. Snails and caterpillars are familiar instances of protective colouring, but this mode of concealment is so general throughout the animal kingdom that it is unnecessary to multiply examples.

Animal Homomorphism is illustrated by the Polyzoa, which outwardly resemble the Hydroid Polypes and corals, though they belong to a different sub-kingdom. Amphibians like *Caecilia* assume a worm-like aspect, and armoured creatures such as the tortoise, armadillo, ganoid fishes and crustaceans present analogous forms. Many of the smaller crustaceans take on a resemblance to various families of insects; some butterflies and moths in general appearance come very near the humming birds. The porcupine is a rodent, the hedgehog one of the Insectivora, their relationship is not so close as one might imagine from their external appearance. Among the Marsupials of Australia forms occur closely corresponding to members of other orders inhabiting other regions. The resemblances of the shrew to the common mouse, of the bat to a bird, and of the whale and dolphin to a fish are examples of homomorphism which will occur to every reader.

Similar habits, if these may be included under homomorphism, are sometimes possessed by animals not closely related. The exceptional habit of the cuckoo is shared by several North American birds belonging to a widely different family. Mr. Darwin mentions species of *Molthrus* allied to the starlings which resemble the cuckoo in building no nest of their own and in laying their eggs in the nests of other birds. A similar habit appears in the cuckoo-bees. There is also the case of the cuckoo-flies, which live as inquilines in the galls of other insects. The ventriloquism or intentional imitation of the mocking bird also might almost be viewed as a case of homomorphism.

The vital phenomena of plants and animals are so near akin that it would be strange if we did not meet with corresponding facts in the vegetable kingdom. Mimicry is perhaps more frequent in the seed than in any other part of the vegetable organism; it occurs, however, in other organs, and even the entire plant body may assume a deceptive appearance. A well-known example is the white dead nettle, which so closely resembles the stinging nettle in size and in the shape and arrangement of its leaves. In systematic position the two plants are widely removed from each other, but they grow in similar situations and are easily mistaken; anyone who has occasion to collect quantities of *Lamium* is almost sure to get his hands stung by *Urtica*, an experience calculated to convince one of the efficacy of protective resemblance. Among animals it is species provided with formidable weapons of defence that are most frequently mimicked by weak defenceless creatures.

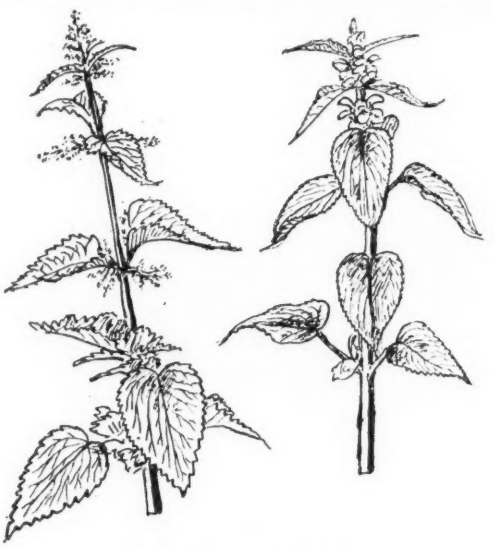

Fig. 2.—Urtica and Lamium.

The stinging nettle is therefore a very likely model for unprotected plants to copy.

A somewhat analogous case is the yellow bugle of the Riviera, which has its leaves crowded and divided into three linear lobes, some of which are again divided. In this the plant differs very greatly from its allies; it has, however, acquired a very striking resemblance to a species of *Euphorbia*, abundant on the Riviera. The acrid juice of the Euphorbias secures them immunity against a host of enemies. As the two plants grow together there is little room to doubt that, like the dead nettle, the bugle profits by its likeness to its well protected neighbour.

The rare heath *Menziesia caerulea*, thought to be protected by its marked resemblance to the Crowberry (*Empetrum nigrum*), has also been adduced as a probable case of mimicry.

Mr. A. R. Wallace in *Tropical Nature* refers to the stone *mesembryanthemum* at the Cape described by Dr. Burchell, which closely resembles in form and colour the stones among which it grows; on this account its discoverer believes the juicy little plant generally escapes the notice of cattle and wild herbivorous animals. Mr. J. P. Mansel Weale mentions that in Karoo many plants have tuberous roots above the soil resembling stones so perfectly that it is almost impossible to distinguish them. The tubers of the potato itself in its native home may perhaps be protected in this way.

The last-mentioned observer has also noted a labiate plant, *Ajuga ophrydis*, in South Africa which bears a strong resemblance to an orchid. As this is the only species of bugle in the district Mr. Wallace thinks the flower profits by the mimicry and succeeds in attracting the insects required for its fertilisation. A species of balsam at the Cape has also acquired an orchid-like aspect. At least one phanerogam bears a lichen-like aspect; *Tillandsia Usneoides*, one of the pine-apple family, grows on trees in tropical America and has a resemblance to a shaggy lichen so marked that it is generally mistaken for a plant of that order. The fly agaric, our most conspicuously coloured fungus, according to Dr. Plowright, is closely imitated by a parasitic flowering plant *Balanophora volucrata*, the scarlet cap, the dotted warts, the white stem and volva being all accurately represented.

THE HISTORY OF FAHRENHEIT'S THERMOMETER.

By SIR SAMUEL WILKS, M.D., LL.D., F.R.S.

THE origin of Fahrenheit's thermometer and the meaning of the scale are not to be found in any work on natural philosophy or chemistry with which I am acquainted, and all the professors whom I have met have expressed like ignorance. Although the instrument appears inexplicable and unwieldy, there is great interest attached to its history, when we learn that it was really invented by Sir Isaac Newton, and that the starting point of his scale was the heat of the human body.

Newton's paper is to be found in the *Philosophical Transactions* for the year 1701. He describes his instrument as a glass tube filled with linseed oil, and to it he attached a scale to measure the degree of heat of the liquid into which he plunged it. His lowest point was that of freezing, as his highest was that of boiling water. He chose for the starting point on his scale the heat of the human body, and this he called by the round number 12, the duodecimal system being then in use; that is, he divided the space between the freezing point and the temperature of the body into twelve parts. He further stated that the boiling point would be about 30, as it was nearly three times that of the human body (*see* Fig. 1).

A few years afterwards, when Fahrenheit was working at the subject of heat, he took Newton's instruments for his experiments, but, finding the scale not minute enough, he divided each degree into two parts, and so made it measure 24 instead of 12. He also did more, for finding he could obtain lower temperatures than freezing, and notably that of ice and salt mixed together, he took this for his starting point. It was from this point he began to count 24 degrees up to body heat. This made, by his measurements, 8 the point for freezing. Boiling point he made 53. It then became zero, freezing 8, body heat 24, and boiling water 53. This was really the same as Newton's, only the scale started lower and the numbers were doubled (*see* Fig. 2).

Later on, finding that he could measure increments of heat more minutely, Fahrenheit divided each degree into four parts. It will now be seen that if the numbers just

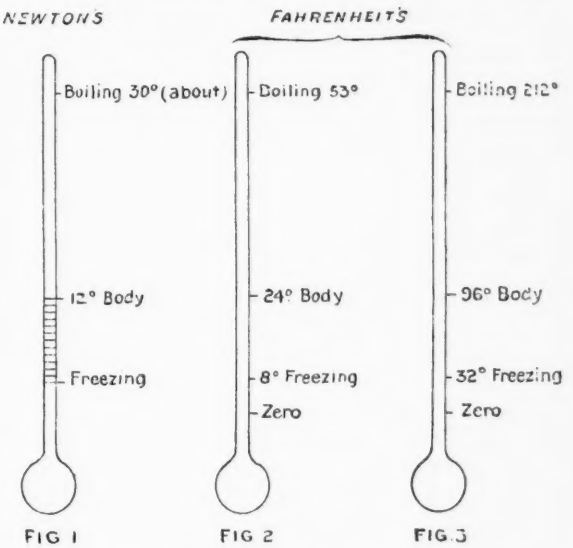

FIG 1 FIG 2 FIG 3

mentioned are multiplied by four we have the thermometer which is now in use. Beginning with zero, freezing becomes 32, the body heat 96, and boiling point 212. This is the scale which Fahrenheit made, and the reasons for his doing so. It is the one which has been in use ever since (*see* Fig 3).

Of late years, when more accurate readings were required, each degree was divided into ten. This brings the decimal system into a scale which was before wholly duodecimal. It may be stated that Newton was aware that blood heat was higher than that which he obtained by placing the thermometer under the arm to measure the body heat.

SILK AND ITS PRODUCERS.

By R. LYDEKKER.

WHEREAS wool, fur, and hair are exclusively the products of a single class of vertebrate animals, namely, the mammalia, silk is as exclusively a product of invertebrate creatures. In place, however, of being produced by one single class, it is yielded in a workable form by certain members of at least three distinct classes of the lower animals, namely, the lepidopterous insects, the spiders, and the bivalve molluscs. At present, however, it is only the product of the caterpillars of a comparatively few species of moths that is of any real commercial importance.

Unfortunately the manufacture of raw silk into the finished article is one of those industries which have to a great extent passed out of the hands of the British workman into those of his foreign rivals; and the Spitalfields hand-loom weaver is almost as extinct as the dodo, while the riband-mills of Coventry have largely been superseded by cycle-manufactories.

According to an article which appeared a few years ago in *Commercial Intelligence*, it seems that during 1898 the imports into Great Britain of manufactured silken goods amounted to over twenty millions in value, while the imports of raw silk were only about one million. Inclusive of the necessary labour, the value of this

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imported raw material when worked up into silk goods would probably not be more than between two and three millions; and it would thus appear that out of a total consumption of some twenty-two or twenty-three millions sterling worth of manufactured silk only a very small fraction is made at home.

The British silk industry has, indeed, been gradually languishing and diminishing for a period of something over sixty years—practically during the whole of the Victorian era. In 1838, according to the same source of information, when the population of the British Isles was only twenty-five millions, the annual consumption of home-made hand-loom woven silken goods was equivalent to eight shillings and sixpence per head. In 1898, on the other hand, when the population was reckoned at about thirty-eight millions, the consumption of silk goods manufactured abroad was equivalent to ten shillings and sixpence per head, while that of British-made silk reached only a miserable eighteenpence per head.

It is not that hand-woven British goods are inferior in quality and wearing power to the foreign articles by which they have been so largely supplanted. Quite the contrary. And now that raw silk is exported from India, China, and Japan in much better condition for manufacture and at a lower price than in 1838, there seems no reason why it should not pay to work it up in this country.

Although the caterpillars of many species of moths make silken cocoons for the protection of their chrysalids, and the cocoons of several of these are used to supply commercial silk, the great bulk of the supply is afforded by the caterpillar of the silk-moth, the so-called "silk-worm." Curiously enough, the silk-moth is a purely domesticated animal, whose wild ancestor is now unknown. Even the real home of this insect is not definitely ascertained, some authorities believing northern China to be the original habitat of *Bombyx mori*, as the species is technically called, while others think that Bengal has a stronger claim to the honour. Be this as it may, the species has been domesticated for an immense period in China, some say since about 1640 B.C.; it was introduced into Constantinople in the sixth century of our era, whence it was carried into France in the year 1494. It is now distributed over a large portion of the globe; and as a consequence of such a wide range and such a long period of domestication it has altered considerably from the parent form, and has likewise developed several local modifications. Evidence of its alteration from the parent form (whatever that may be) is afforded by the aborted condition of the wings of the adult moth, which are so weak as to render the insect incapable of flight. By some it has been said that if the moths be reared in the open air in perfect freedom they will recover the power of flight in the course of a few generations, but since it is also stated that the caterpillars when turned out on trees are helpless, this requires confirmation. Variation is shown by the fact that in one breed the cocoon is yellow while in another it is white; and this, coupled with other variations, has led some authorities to believe that the domesticated form is derived from more than one wild species. This view has, however, not met with general acceptation.

The silk is found within the body of the caterpillar in a pair of glands of somewhat complex structure, and is there in a viscid condition. The ducts of the two glands unite into one common channel, so that their products are united before emission into a single thread, which in the last part of the apparatus is coated with a kind of waterproof varnish. As "silkworms," probably owing to the artificial conditions under which they are reared and in-and-in breeding, are subject to many diseases, especially about the period of pupation, attempts have been made to convert the viscous matter in the bodies of the caterpillars into silk by artificial means. But although the secretion can be drawn out into threads of considerable fineness, it resembles catgut rather than silk, and has no power of resisting the effects of water. A still more bold attempt has been made, namely, to obtain silk direct from the mulberry leaves on which the silkworm feeds; but this, as might have been expected, resulted in complete failure, many of the workings in nature's organic laboratories being too subtle for imitation by any of the means at man's disposal. It may be added that although silk of good quality is produced by silkworms reared in Britain, the thread is so short as to render it of little or no commercial value.

The best and most valuable silk is yielded by the white cocoons; but of these there are two descriptions, known in the trade as first and second white. The yellow cocoons, which are the most numerous, are divided into three classes according to size; the small and medium-sized cocoons being of higher value than the larger ones. The cocoons of other breeds vary in colour from greenish white to pure or reddish green; while there exists a Tuscan breed of silkworm which produces pale rose-coloured cocoons, and purple cocoons have also been reported. The breed yielding white cocoons, known in France as *sina*, appears to have been produced from the yellow-cocoon breed by careful selection, since a certain percentage of yellow cocoons always appears among the white ones. By the exercise of great care the percentage of yellow cocoons, which formerly had been much larger, was reduced many years ago in France to a very few per thousand.

The silk-moth is the typical representative of a family of moths (*Bombycidæ*), characterised by the absence of a proboscis, and the presence of one internal nervure on the hind-wing. A second family of silk-producing moths—the *Saturniidæ*—differ from the *Bombycidæ* by the presence of two or three nervures in the hind-wing. Among these are some of the largest of all moths; and the majority of them are characterised by the presence of a clear transparent spot or "window" in the centre of each wing; the transparency being, of course, due to the absence on these areas of the minute scales which cover the remainder of the wings. Hence they may conveniently be called window-moths. The use of this very peculiar type of marking is at present quite unknown, but it is probably of some considerable importance in the economy of these insects.

In Japan the great silk producer is a large yellow window-moth, measuring nearly seven inches across the wings, known as the yama-mai (*Attacus yamamai*), the caterpillar of which feeds on oak-leaves. It produces large green cocoons yielding an excellent silk, second only in quality to that of the silk-moth. For a long time the exportation of this insect was forbidden, but eggs from time to time found their way to Europe, where attempts were made to acclimatize such a valuable species. All these attempts were, however, attended by failure. Although the cocoons are bright green, the silk in their interior is of a silvery white.

Another species which it has been attempted to introduce into France is the Manchurian window-moth (*Attacus perryi*), whose caterpillar likewise feeds upon

the oak. Cocoons were first sent to Lyons, from which moths were in due course hatched out, and shown at the Paris Exhibition of 1855. The silk has some of the properties of wool and cotton, as well as of ordinary silk, and thus approximates to the Tusser (or Tusseh) silk of India, a name which is commercially applied to the produce of many of the window-moths. Of the true Indian Tusser moth (*A. mylitta*), which is found both in lower Bengal and the Punjab, the silk is perhaps even more valuable than that of the species last named. The silk is so coarse and knotty that it has to be carded instead of wound, and from it are made the well-known khaki-coloured tusser fabrics that are almost indestructible with fair usage. An excellent account of this moth and its silk is given by Mr. Cotes in an article on the "Wild Silk Insects of India," published in *Indian Museum Notes* for 1891, where mention is also made of other kinds of silk-producing species. Among these latter is the Atlas moth (*A. atlas*), which is one of the largest in the group. Its caterpillar is pale olive-green and lavender in colour, with a conspicuous D-shaped scarlet mark on either side of the hinder end. Like those of other members of the group it is armed with a number of spine-like warts.

The species that has perhaps attracted the largest amount of attention is, however, the ailanthus moth (*A. cynthia*), which is a native of Japan, where the caterpillar feeds on the ailanthus, or false Japanese varnish-tree. The wings of this handsome moth are ornamented by a conspicuous white line, externally to which is another band of rose; each wing also having a crescentic spot. This fine species was introduced into France in 1857 or 1858, where it has since been acclimatized, its food-plant flourishing well in that country. At first the cocoons could be made to yield by carding nothing more valuable than short-fibred floss-silk, but subsequently means were devised of obtaining long threads of an excellent description of silk. The ailanthus moth is found in China as well as in Japan. In India it is replaced by the closely allied castor-oil moth (*A. ricini*), which yields a silk of very similar character. By some writers this species is regarded only as a variety of the last. Darwin, in his "Animals and Plants under Domestication," states, for instance, that "the Arrindy silk moth (as it is often called) introduced from Bengal, and the Ailanthus moth from the temperate province of Shan Tung, in China, belong to the same species, as we may infer from the identity in the caterpillar, cocoon, and mature states; yet they differ much in constitution; the Indian form 'will flourish only in warm latitudes,' the other is quite hardy and withstands cold and rain." Apart from its tender constitution, the difficulty of cultivating the castor-oil plant, even in the south of France, offers an obstacle to the permanent acclimatization in Europe of the first-named form.

Omitting mention of certain other silk-yielding caterpillars, a few lines may be devoted to the subject of spider-silk. The gossamer-like nature of this delicate substance is familiar to all; and in fineness and tenuity the threads far surpass ordinary silk. From time to time more or less successful attempts have been made to utilize this substance; and recently a manufactory has been established in France where the ropes for military balloons are made from spider-silk. The factory is situated at Chalais-Meudon, near Paris. The spiders which supply the silk are arranged in dozens above a revolving reel, upon which the threads are wound; each spider furnishing from thirty to forty yards of thread. After the removal by careful washing of the reddish sticky outer layer, the threads are twisted into a yarn, which, although considerably more expensive, is both lighter and stronger than a cord of caterpillar silk of the same calibre. One of the chief difficulties connected with the manufacture is the feeding of the spiders.

The third and last description of silk used for manufacture is afforded by the *byssus*, or mooring-rope of the great mussel-like bivalve commonly known by its Italian name *pinna*, a word which properly denotes the fin of a fish, but is applied to the shell on account of its fin-like shape. The pinna, which grows to a length of two feet or more, is a semi-translucent shell shaped like an isosceles triangle; the byssus issuing on one side from between the two valves a short distance from the apex. This byssus consists of a silk so fine in quality as to produce a most delicate fabric when worked up. Although the supply of this pinna silk is too limited to be of any commercial importance, it has from time immemorial been manufactured into small articles of dress, such as gloves, stockings, and caps, at Taranto. Originally these were reserved for imperial or royal use, and at the present day are made rather as objects of curiosity than of use; the manufactured silk is of a delicate hair-brown colour. For some reason or other the pinna-silk is mixed with about one-third its bulk of ordinary silk previous to being woven. Some years ago the price asked for a pair of pinna-silk gloves at Taranto was six lire, while eleven lire were demanded for a pair of stockings. Specimens both of the byssus and of the manufactured silk are exhibited in the Natural History Museum at South Kensington.

In addition to its importance as the chief silk-producer of the world, the silk-worm also yields the finer descriptions of the substance known by the not very elegant title of "catgut." To obtain the catgut, or "gut," the silkworms must, however, be killed just before they commence cocoon-spinning, so that silk and gut cannot be obtained from the same individuals. Consequently the finer descriptions of gut, such as that used by the fly-fisher, are expensive.

The great manufactory of fine gut at the present day is situated on the island of Plocida, in the Bay of Naples, where, however, only a small proportion of the silkworms necessary for the manufacture are raised, the great bulk of these caterpillars being obtained from Torre dell Annunziata and other towns in the neighbourhood, where there are large silkworm-breeding establishments.

According to an account published a few years ago, the process of manufacture of "fili di seta" ("silk-threads") as the gut is locally termed, is as follows:—The silkworm is selected when fully matured, that is to say, at the moment when its nourishment ceases, and just before its metamorphosis. It is then cut open, great care being taken not to injure the membrane of the silk-glands there, which usually reach the length of thirteen to twenty mms., with a diameter of one and a half to two mms.; these are then removed, and put into a pickle, which is the keynote of the whole process, and the secret of which is carefully kept. When the pickling process is over, the work-people, who are mostly women, take one end of the gland in their teeth and draw the other end with their hands. This part of the work requires great dexterity, for the threads are drawn out to the length of from thirty to fifty cms., and the whole value of the product depends upon its length in relation to its thick-

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ness, and the strain it will carry. There are two seasons for the production, namely, in spring, when the best gut is produced, and in autumn, when the quality is inferior. There is an important market for this speciality, and the whole production is exported to Northern Italy and abroad at the average price of one hundred and fifty lire per kilo. The gut is of very small specific gravity, so that a great deal of it goes to a kilo. The cost of production is also considerable, since the silk-worms must be bought just at the moment when they are coming into profit for making silk, that is to say, when they are at their dearest. Again, the results are frequently disappointing, many of the caterpillars being found, on dissection, unsuitable, so that they have to be rejected.

THE USE OF HAND TELESCOPES IN ASTRONOMY.

By CECIL JACKSON.

My object in writing these papers is to demonstrate the usefulness of hand telescopes even for astronomical work. Quite small pocket telescopes will do much interesting work; they are to the astronomical observer what the hand magnifier is to the microscopist. The instrument should, however, magnify not less than about ten diameters.

With such an instrument all the principal craters in the moon may be seen. The sunspots can also be observed, if care be taken to protect the eye from injury by using a dark glass. Should no dark glass be used, the sun must only be observed when largely obscured by fog. The disc of the planet Jupiter can be seen with a pocket telescope.

For the observing of planets it is sometimes desirable to remove one of the four lenses of the eye-piece. The lens next but one to the eye-end of the telescope is the one to be removed. The instrument is then to be used with the other lenses in their usual positions. After the removal of the lens, the magnifying power of the telescope will be found to be considerably increased, but only the centre of the now restricted field of view will be available for distinct vision.

A good way of holding a small glass is to grasp it between the fingers of either hand like a penholder, and then to rest the hand on some upright support. Steady yourself with the other hand after adjusting the telescope to your eyesight. In adjusting the eye-end for clear vision, do not push the draw-tube straight in, but twist it with a spiral motion. A very good way of holding a telescope quite steadily is to arrange the two sashes of a window, one just so much above the other that the telescope, when resting on them, is inclined at the proper angle for viewing any object you may wish to look at through the open window.

I.—THE MOON.

I shall suppose the observer to commence with the moon, and I shall now describe some of the objects visible on its surface, with the help of a three-draw telescope having a $1\frac{5}{8}$-inch object glass and a magnifying power of from 25 to 35 diameters. A good $1\frac{1}{2}$-inch telescope will bear a power of about 60 diameters, and a 2-inch land telescope a power of about 80 diameters.

Fig. 1 shows the moon when $3\frac{1}{4}$ days old at about 8h. 12m. p.m., June 27, 1892.

The largest craters shown in this sketch can, however, be seen with a smaller telescope if looked for closely, and the glass fixed or held quite steadily. A is Langrenus; B, Vendelinus; C, Petavius; D, E, mountains on the north and south boundaries of the Sea of Conflicts (Mare Crisium). These mountains may be seen as two lines of light projecting beyond the crescent moon.

Fig. 2 represents the moon at about 4h. 8m. p.m., Jan. 12, 1894. Moon's age, about 5d. 13h.

A—Theophilus, Cyrillus, and Catharine. This fine group of craters may be well seen with a $1\frac{1}{2}$-inch telescope having a magnifying power of 25 or 30 diameters. Cyrillus and Catharine are connected by a striking valley; while Theophilus intrudes on Cyrillus on its north-west side. The western limb of the moon is the right-hand one as seen in a non-inverting telescope. B is a fine group of interlacing craters; the largest of which is called Janssen. This is a very

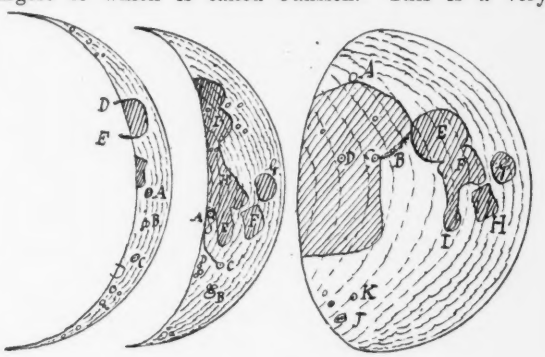

FIG. 1. FIG. 2. FIG. 3.

striking group when the moon is from four to five days old. In the late summer, or early autumn, these formations should be viewed when the moon is waning, about three or four days after full moon. The waxing moon is best seen from January to June, and the waning moon from June to December. C, Piccolomini; D, Altai Mountains; E, Sea of Nectar; F, Sea of Fertility; G, Sea of Conflicts; H, Sea of Tranquillity; I, Sea of Serenity. In the telescope, the "Seas" appear as vast plains. The boundary line between light and darkness ceases to be jagged where it crosses any one of these plains, thus proving that the lunar surface is comparatively level here.

Fig. 3 represents the moon as seen at about 8h. 20m. p.m., May 15, 1894. Moon's age, about $10\frac{1}{4}$ days.

A, Plato. This is a fine crater, of which the floor darkens towards full moon. Any good pocket telescope will show it. B, Lunar Apennines. This fine range of mountains presents a grand spectacle at about the time of First Quarter in the waxing moon, or about the beginning of the Last Quarter in the waning moon, when it may be seen as a line of light apparently projecting from the half moon into the sky. C, Eratosthenes. D, Copernicus, a splendid crater, and the centre of a streak-system in the full moon. E, F, G, H, I, Seas of Serenity, Tranquillity, Conflicts, Fertility, Nectar respectively. J is Clavius, a magnificent crater presenting a striking spectacle in an instrument magnifying 30 diameters, which will show it to have two craters on its floor, as well as two others adjoining its wall. The diameter of this object is 142 miles. K is Tycho, which is the centre of a wonderful streak-system, which can be well seen with a small telescope. One streak runs across the Sea of Serenity, E. Tycho itself is 54 miles in diameter, and has a central hill, well seen with a power of about 30 diameters.

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THE CORONA ROUND THE SOUTH POLE OF THE SUN.

TOTAL SOLAR ECLIPSE, MAY 18, 1901.

From a Photograph with the Newbegin Telescope, at Mauritius.

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THE POLAR RAYS OF THE CORONA.

By MRS. WALTER MAUNDER.

THE corona of 1901 was of the most pronounced minimum type, its form was simpler than any of which astronomers have had experience since 1889. This circumstance, though it may seem to detract from its beauty and interest in some respects, is not without its advantages, as the relations of many of its details can be more distinctly followed and their significance better appreciated.

Especially is this the case with regard to the structures immediately round the two poles of the sun's axis. At times of maximum, the great synclinal rays are found, not merely in the neighbourhood of the sun's equator, but all round the limb, and the polar rays are obscured by the more conspicuous type of formation. But in an eclipse like that of last May, the polar regions are left absolutely free except for the beautiful and regular tufts of light which have earned for themselves the appropriate name of "plumes" or "panaches." These are then seen there in utmost distinctness, and can be studied to greatest advantage. No doubt structures similar in general character may exist in every region of the corona, both at minimum and maximum, but in the equatorial regions the greater brightness of the great synclinal curves, and the complexity shown by the regions of the corona close to the sun's limb, prevent the "plumes" from being easily recognised.

Restricting our attention for the present to the rays round the southern pole, they present something like the following appearance. Starting from the great south-east synclinal group, we find that the first polar rays are drawn over into a curvature which nearly, though not precisely, conforms to the southern outline of that formation. As we approach the pole the rays are less and less curved, till at the pole itself, and in its immediate neighbourhood, we find them as straight as if they were ruled. And this change of shape is not confined to the bright rays. Between the bright rays there are dark streaks—whether we regard them as mere rifts or interspaces, or as actually dark rays, having an objective existence, as being, in other words, an absorption and not a mere contrast effect—showing precisely the same excessive curving near the south-east synclinal group, and straightening gradually as they approach the pole until they become there as truly rectilinear as the bright rays amongst which they are found. Proceeding from the pole towards the west, we find in like manner that the curvature of the rays increases the further we get from the pole, although we do not get the same extreme bending noticed on the east. But it is noteworthy that the south-west equatorial wing is more diffused than the south-east; its outline is not so sharp and well defined, and the curve of that outline is much gentler, except at one particular point with which I am not at present concerned.

The dark rifts or rays interspersed between the bright polar rays deserve special attention. Many of these appear to be, and probably are, mere contrast effects, interspaces between the bright rays. But others seem to me to be of quite a different order. Thus on the east of the pole we find two bright rays, the curvatures of which lead them apart from each other the further they recede from the sun. The dark space between them therefore broadens the further we go from the limb. But within this space we find an intensely black line; not a contrast effect, for it borders neither of the bright rays, it does not broaden as it recedes from the sun, but is equally narrow throughout, and its curvature corresponds to that of neither of the bright rays between which it runs. More remarkable still it can be traced further from the sun than the bright rays. A similar remark applies to another ray even longer and darker than the first, that springs almost exactly from the sun's pole.

The polar rays towards the west appear to show some evidence that they are not in the same plane. To the extreme west two short bright rays of considerable curvature appear to be distinctly nearer to the spectator than a pair of straight rays which make a considerable angle with the solar axis. The more westerly of the pair would indeed seem to be partly hidden by the curved rays; the more southerly in its turn appears to conceal the lower portion of three straight rays, which show a slighter divergence from the solar axis. Elsewhere in the corona of 1901 there were similar indications, none very strongly marked, of a certain amount of relief. The general effect of this corona, as of all coronæ, is of that of an essentially plane phenomenon. The impression produced is that of a superficies, not of a solid; of a body having extension in two dimensions, not in three.

Yet we know for a certainty that the material composing the corona must be distributed in all three dimensions; taking one eclipse with another it must on the average be equally extended in all solar longitudes. We are looking down upon the sun day by day through a depth of the corona which on the average corresponds to its mean depth as seen in the tangential plane.

This consideration is so certain that it has led to the system of polar rays being regarded as in fact a sub-polar ring, the pole itself being bare. But at a distance from it of about 20° or 25° a number of rays rise from the surface and all of them bend over towards the sun's equator. On this theory, those rays which lay very nearly in the line of sight would necessarily appear to us to be straight or nearly straight, through the effect of foreshortening, and would be seen by projection in the apparent neighbourhood of the pole. It has been further suggested that this ring of rays would be a phenomenon essentially similar to our terrestrial auroræ, the long coruscations of which have frequently impressed themselves upon observers as resembling in appearance these polar rays of the corona. But indeed this latter suggestion is a very superficial one, and entirely ignores the difference between the positions of the spectator in the two cases. In the case of a terrestrial aurora we may indeed see the rays shooting up from low down in the north, high across our zenith, but we have no guide by which we can tell as to whether those rays are really rising or falling in our atmosphere, or as to whether, which is far more probable, they are moving practically at one given level; their apparent rise or fall being simply the effect of perspective. So far as our knowledge goes, a terrestrial aurora, watched from the moon, would seem to be essentially a surface phenomenon; as entirely so as the streaks which radiate from Tycho or Copernicus appear to be to us.

The difficulty which we have in regarding the polar rays as situated in a ring at about 65° of solar latitude lies here; that in such a case they should obviously be much more crowded together as we approach the greatest apparent distance east and west from the pole, whilst near the pole they should be considerably shorter and fainter, and much more sparsely scattered. In other words, not only would there be a marked flattening of the corona itself at the two poles, but the polar rays would show such flattening among themselves. But in general these features are just what are not seen. The straight rays close to the pole are in general at least as long and as bright as those nearest the synclinal groups, and they are nearly, if not quite, as closely packed. Yet a careful examination of the region before us does show a certain crowding towards the

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east, whilst close to the great dark ray at the pole a broad but short bright ray is clearly seen, which may very well have its rise in a latitude some 15° or 20° from the pole, either on the side of the sun nearer to us, or on that more remote.

The indications of relief in the corona, which the present plate affords, slight though they may be, are of importance, as they tend to remind us that the corona, in spite of that essentially flat appearance which it generally presents, must in reality have a great extension in the line of sight. It is a fact of which we need to be reminded, since it is so easy to forget it, and it has often been ignored in discussions upon its structure and nature. And indeed it seems very difficult to reconcile it with some features of its actual appearance. The dark rays, for instance, whether we regard them as mere interspaces between bright formations, or as having a distinct and separate objective existence, are exceeding hard to account for in a structure in relief. Then, again, in the coronæ of 1900 and of 1901, and we might add also in the more complicated one of 1898, the great mass of the corona was comprised in a very few striking formations of the character known as synclinal groups. In 1900, three of these were recognised, in the other two years, four. On all three occasions these structures had the most enormous extension, reaching on the average a distance of about three solar diameters from the centre of the sun. It is clearly not conceivable either that the structures which were visible were exactly where they appeared to be, in a plane at right angles to the line of sight, or that the moon concealed from us at the most more than two or three structures of similar character and extent. The picture, therefore, that is conjured up to our mind of what would be visible to us, could we look down upon the sun and see the corona on all sides at once and in full relief, is that of about half a dozen or so of these monstrous excrescences distributed irregularly round the sun; whilst about one-tenth of the solar surface, that immediately surrounding the two poles, would be given up to a few "plumes," few, that is to say, relatively to the area engrossed by them.

Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

THE SPECTRUM OF LIGHTNING.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—The reproduction of a photograph of the spectrum of lightning on page 6 of the January number of this magazine is intensely interesting, and, so far as my experience extends, unique. I should indeed be glad to know how the hydrogen lines in that spectrum are to be accounted for. I presume that that element must for the time being exist in a free state in that part of the atmosphere in which a "thunder-storm" may be raging; but the question arises, How comes it there in sufficient quantity to thus indicate its presence? Are we allowed to assume that the passage of an electric discharge through a portion of the atmosphere decomposes the water-vapour therein into its constituents, oxygen and hydrogen; and that, further, the freed hydrogen is thus raised to incandescence and so made to manifest its presence? I should like to hear through some aeronaut if samples of our atmosphere have ever been taken at an altitude of from, say, one to two miles, which have been found to contain even ammonia in any appreciable quantity. Prof. Pickering remarks, in connection with the photograph under consideration, "A number of photographs were taken in this way, and showed the curious fact that the spectrum of lightning is not always the same." I do not just now see how they are likely to be precisely similar.

38, Burrard Road, WILLIAM GODDEN.
West Hampstead, N.W.,
12th January, 1902.

RAINBOW BEFORE SUNRISE.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—Perhaps it may interest Mr. Johnson to know that I saw the same rainbow at Blackheath which he witnessed at South Croydon (*see* KNOWLEDGE, January, 1902, p. 11). I have a particular reason to remember the date, as I was going a few miles later in the day to see a relative in the country, and was rather anxious to learn whether it was also visible there, but could get no information on that point *à cause de la bonne heure*. The time during which I noticed the bow agrees with that by Mr. Johnson, from 7.15 to 7.30, and I remarked that I did not remember ever before seeing a morning rainbow in which the whole arch was so complete and of uniform brilliancy. W. T. LYNN.

Blackheath, January 1st, 1902.

HOAR FROST.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—In Mr. Bell's interesting article on this phenomenon in KNOWLEDGE for November last two rather curious facts are not referred to. On calm frosty nights there is generally a slight air-current moving, and the direction in which it moves is always indicated by the position of the lines of ice-spicules, especially on the edges and corners of railings, walls, leaves, etc. One's first impression is that these lines of icy points are blown away from the wind and point down the current like flags. But the contrary is the fact. They are built up in the teeth of the current and point "up wind" to the direction from which it comes, like a vane. Such lines of hoar frost are often formed along the telegraph wires, and it is not uncommon to see the wires on such occasions curiously vibrating. The cause of this is a little puzzling, but I think it may be accounted for by a slight change in the direction of the current after the formation of the line of frost spicules. These spicules stand out like the teeth of a comb on one side of the wire only. If the current changes and now strikes them at an angle the pressure will cause a slight torsion of the wire until the resistance overcomes the pressure, when the wire will spring back and the same process will be repeated. F. T. MOTT.

Birstal Hill, Leicester,
December 17, 1901.

A POISONOUS SHRUB.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—I hear, from the best authority, that there is an oak tree supposed to possess curious properties in the domain of the Earl of Annesley (Co. Down). For several years certain members of the family had suffered during autumn from a sort of skin eruption, and this season the symptoms were more pronounced, head and hands became swelled and inflamed, and feverishness supervened, the whole malady somewhat resembling erysipelas. It has been discovered that only those who touched the leaves of this oak were thus affected, and the secret cause of the complaint was definitely traced to irritation produced by handling them. We all know

that the *Primula obconica* brings out a rash upon unwary admirers, but I had no idea that our sturdy old friend *Quercus* would act in the same way.. Perhaps your readers could throw some light on the subject, and inform us to what species such an oak would belong?

C. MAUD BATTERSBY.

Cromlyn, Rathowen, Ireland,
November 19th, 1901.

[In reply to a request for information, Lord Annesley writes that the tree in question is *Rhus toxicodendron*. This is a North American shrub, belonging to a genus of which many of the species are highly poisonous. It belongs to the order *Anacardiaceæ*, and though called "Poison Oak," is in no way related to the true oaks, the genus *Quercus*. The member of the genus most familiar to British plant-lovers is the Staghorn Sumac, *Rhus hirta*, which is frequently seen in cultivation.—R. LL. P.]

Conducted by HARRY F. WITHERBY, F.Z.S., M.B.O.U.

A MURDEROUS WATER RAIL IN LONDON.—On Sunday, December 22nd last, I was watching a Water Rail hunting for food in the rushes and patches of open water at the top of the Serpentine, which was frozen. There were some Sparrows about, one of which settled on some broken rushes near the Rail. The Rail immediately rushed at the Sparrow and seized it, apparently by the neck, in its long slender bill. The struggle which followed took them to a patch of unfrozen water, where the Rail "ducked" its victim and left it half-submerged on the edge of the broken rushes. The Sparrow died in about five minutes. Some ten minutes afterwards the Rail caught sight of the body, and going up to it gave it a few pecks, but did not attempt to eat it, so that hunger could not have been the cause of its strange action. On the following Friday I again saw the Rail in the same place; when it happened to get near the Sparrows it looked at them, but they were evidently frightened and flew up. The Water Rail must be rarely seen in London, and to find one acting in this extraordinary way seems worthy of notice.—F. R. RATCLIFF.

The Starling Roost on Cramond Island. By Charles Campbell. (*The Annals of Scottish Natural History*, January, 1902, pp. 2-9).—This is an interesting article on the flighting habits of the Starlings which roost on Cramond Island in the Firth of Forth. Starlings have roosted in great flocks for some years past in a small plantation of Scotch firs on this island, but it was not until the autumn of 1899 that they began to excite general attention in the neighbourhood. The result of the author's interesting observations may be summed up as follows:—The Starlings perform their daily journeys to and from the island with great regularity. No matter what the weather may be, and however strong the wind, they regularly perform their journeys across the Forth. They roost on the island in summer and in winter, although their numbers are lessened in the breeding season. No Starling remains on the island at any time of the year during the day. It is supposed that on their reaching the mainland in the morning the birds separate into small companies which have their particular feeding grounds. In the evening they gather together somewhere inland, and often pass over the Forth in one enormous flock.

Red-throated Pipit in Sussex.—At the meeting of the British Ornithologists' Club held on December 18th, 1901, Mr. Howard Saunders, on behalf of Mr. L. A. Curtis Edwards, exhibited a specimen of a Red-throated Pipit obtained at Ninfield, Sussex, on November 26th, 1901. It was in perfect plumage, and was evidently a young bird which had just completed its first moult. The Red-throated Pipit has been identified in Great Britain on very few occasions. For the cause of its apparent scarcity I would refer my readers to a note on the subject in KNOWLEDGE for September, 1901, p. 204.

Scops Owl in Kent.—At the same meeting referred to above a Scops-Owl was sent for exhibition by Mr. Collingwood Ingram. The specimen was caught alive in a coachhouse at Broadstairs in March, 1898. The bird eventually died and its skin was preserved. The Scops-Owl is only a summer visitor even to temperate Europe, and is seldom found so far north as the British Islands.

Waxwings in Scotland.—In the *Annals of Scottish Natural History* for January, 1902, it is pointed out (p. 52) that there has been a decided immigration of Waxwings to Scotland this winter, but though widely scattered over the country the birds have not come in considerable numbers. The Waxwing is somewhat capricious in its visits, which depend, no doubt, upon the severity of the weather on the Continent,

Great Snipe in Shetland and in Orkney (*Annals of Scottish Natural History*, January, 1902, p. 54).—There are few authenticated occurrences of the Great Snipe in Scotland. Mr. J. A. Harvie-Brown now records that one was shot on September 26th, 1901, in Shetland, while Mr. Robert R. Bell notes that two others were shot on September 25th, 1901, in Stronsay, Orkney. The Editors append a note that a further Great Snipe was shot near Castle Douglas during the past autumn.

Green Sandpiper in the Outer Hebrides (*Annals of Scottish Natural History*, January, 1902, p. 55).—A Green Sandpiper, a bird which has not previously been recorded from the Outer Hebrides, was obtained in South Uist during the past autumn.

On the Increase of the Starling and the Hawfinch. By H. E. Howard, F.Z.S. (*Zoologist*, December, 1901, pp. 463-467).—The author of this paper has found that the great increase of the Starling of late years, a fact which is universally admitted, has tended to drive away and cause a decrease in other birds which nest in holes of trees. In KNOWLEDGE for July, 1901, I pointed out how that the Starlings were driving away the Nuthatches especially, from the New Forest. Mr. Howard goes further and affirms that the Starlings evict even the Green Woodpeckers from their nests in his district. In my experience, however, the numbers of the Woodpeckers (which can bore nesting holes for themselves) has not been at all lessened by the increase of the Starling. I may add as a point of some interest that in the New Forest the Nuthatches return in considerable numbers in autumn and winter, and that the Starlings, which are now so numerous in the breeding season, forsake the Forest as soon as their young are fledged. Mr. Howard has also noted a large increase in Hawfinches, which he deplores from an economic standpoint owing to the great damage these birds do to fruit trees and vegetables. He traces the increase of both these birds to the growth of the human population and the consequent augmentation of orchards, market gardens, and other suitable feeding grounds. It might be suggested that the unusually mild winters and dry summers of the last few years should be taken into consideration as a possible important factor.

Yellow-billed Cuckoo (Coccyzus americanus) at Ringwood, Hants (*Zoologist*, December, 1901, p, 474).—Mr. G. B. Corbin records that a specimen of this American bird was shot at Ringwood, on October 30th, 1901. The bird was in perfect plumage, and showed no signs of abrasion in its feathers. For remarks concerning the occurrence of this and other American species *see* KNOWLEDGE, January, 1902, p. 16.

The Ringed-necked Duck as a British Bird (*Zoologist*, December 19th, p. 476).—Mr. O. V. Aplin here asks why this species (*Fuligula collaris*) of American Duck should not be included in the list of accidental visitors to Great Britain. The bird was originally described by Donovan in 1801 from a specimen obtained in Leadenhall Market, and said to have been shot in Lincolnshire. Mr. Aplin justly remarks that a hundred years ago no wildfowl came imported for the table from the other side of the Atlantic to London, but were not wildfowl imported for ornamental waters, and might not this bird have escaped?

All contributions to the column, either in the way of notes or photographs, should be forwarded to HARRY F. WITHERBY, ***at 10, St. Germans Place, Blackheath, Kent.***

XUM

NOTES.

Astronomical.—The discovery by Dr. Stewart of a new minor planet of more than average interest is announced by Prof. E. C. Pickering. A photograph, taken on August 14th last, revealed the presence of the planet, and later photographs showed that its daily motion was uncommonly large. A preliminary computation indicated that the planet was nearer to the sun than any other of its class at present known. Prof. Newcomb finds that the period is 4·13 years, the mean distance 2·57 that of the sun, the eccentricity 0·377, and the inclination 18° 38′. The new planet is now moving rapidly northwards, having crossed the equator about the 20th of January. Mr. S. B. Gaythorpe has drawn attention to the fact that the eccentricity of the orbit of the new planet is slightly less than that of Æthra—(132).

Continued investigations have established the reality of the changes in position of parts of the luminosity of the nebula surrounding Nova Persei, and explanations which aim at avoiding the seemingly impossible velocities which an actual translation of matter would require, are being put forward. Prof. Kapteyn and Mr. W. E. Wilson have independently suggested that the light of the nebula is reflected from the Nova, and that the apparent motion is nothing more than the progression of the light rays to nebulous or meteoritic matter situated at gradually increasing distances. On account of the vast distances of the nebulous matter from the Nova itself, it is supposed that the light of the original outburst may have taken months to reach it, so that the nebulosity did not appear until the star had greatly decreased in brilliancy. Sir Norman Lockyer has suggested that the luminosity of the nebula is produced by collisions of meteoritic matter, and that it is the loci of disturbances which are varying in position. A difficulty which presents itself is that the most prominent part of the nebula retained practically the same form during its movement. —A. F.

Botanical.—Monsieur Laurent has an interesting paper in the *Comptes Rendus de l'Académie des Sciences, Paris*, of December 2nd, 1901, respecting the poisonous action of the mistletoe on certain varieties of pear, shown by the sudden dying off of the young branches during the heat of the summer. At the point of contact of berries, seeds, or young plants of the parasite with the bark of the pear tree, and even for several centimetres around it, the cortical parenchyma is killed and contracted, the vessels become choked up with gum, which interferes with the passage of the sap, in consequence of which the neighbouring leaves wither, and ultimately the branch dies. A single young plant of the mistletoe was found sufficient to kill a branch several years old. Though the poisonous principle resides in the pulp of the berries and in the seeds, it is most abundant in the young plants. The curious fact has been noticed that the mistletoe will not establish itself on some varieties of pear. This is shown to be due to the early death of the cortical tissue at the points where the seeds of the parasite germinate, and the young plants die before the haustoria can penetrate the bark of the host. Monsieur J. Chalon has observed that the mistletoe has a similar poisonous action on *Spartium junceum* and *Ficus elastica*.

Professor Matouschek, writing in the *Deutsche Botanische Monatsschrift* of December, 1901, mentions that an exceedingly fine female specimen of the yew growing in the village of Ungersdorf, Moravia, does not fail to produce its well-known fruits, though no male plant grows in the vicinity. On investigation he found that the pollen, which is conveyed to the female flowers by the wind, must have travelled upwards of five kilometres, the distance from Gaisdorf and Leipnik, where the nearest male specimens are met with.

It is well known that certain plants or parts of plants are difficult to dry satisfactorily. For instance, *Orobus niger* and many Scrophulariaceæ (*Pedicularis, Melampyrum*, etc.), which turn black during the process of drying, and flowers, which often lose their characteristic colours. Professor Rostowzew describes in *Flora*, 1901, Heft 3, two methods of drying botanical specimens, which have given excellent results. In that recommended for general use, pads of absorbent cotton about half an inch thick, and each wrapped in a sheet of tissue paper, are substituted for the ordinary drying material. The other method is termed drying plants on a metal cylinder, and is especially applicable to succulent specimens. Its salient features are a hollow metal cylinder, freely perforated at the sides, and covered at the top with a metal lid. The cylinder is tightly covered with a linen cloth on which the specimens, placed between layers of drying paper, are fastened. It is then stood on a tripod and a lamp applied at the bottom. The heat from the lamp will quickly expel the moisture from the specimens.—S. A. S.

Zoological.—Some months ago an article appeared in our columns on the manner in which Arctic mammals turn white. Important additional information with regard to the manner in which hair bleaches is afforded by a communication from Mr. E. Metchnikoff, recently published in the *Proceedings* of the Royal Society. It is there stated that the all-devouring cells known as phagocytes are the cause of the mischief. These cells, which frequently have amæba-like processes, are developed in the central or medullary part of the hair, whence they make their way into the outer or cortical layer, where they absorb and thus destroy the pigment-granules. Numbers of these phagocytes may be seen in hair which is commencing to turn white.

"The part played by phagocytes," writes the author, "in the whitening of hair explains many phenomena observed long ago, but not as yet sufficiently understood." Thus the phenomenon of hair turning white in a single night, or in a few days, may be explained by the increased activity of the phagocytes, which remove the pigment within an abnormally short period.

It appears from a communication published some time ago in our American contemporary, *Science*, that the California Fish Commission ordered the destruction of 10,000 sea-lions on the coast of that State, on account of the damage they do to the salmon fishery. It was expressly stated that the seals were not to be exterminated, but only a third of their number destroyed. Dr. C. H. Merriam points out, however. that 10,000, in place of representing a third of the number of these animals, probably exceeds the total. And he further points out that these sea-lions feed almost (if not quite) entirely on cuttles and squids, and do not touch fish. As Dr. Merriam observes, the fact that sea-lions in captivity will

eat fish rather than starve, is no argument that they do so in their native state, when their stomachs are invariably found to be filled with the remains of cephalopods.

When the primeval ox of Europe ceased to exist as a wild animal, its name—aurochs—became transferred to the bison, and it is only of late years that it has been relegated to its proper owner. A similar transference of names has taken place in the case of the extinct South African blaaubok (*Hippotragus leucophœus*), whose title was long assumed by the roan antelope, of which a woodcut appears in Wood's *Natural History* under the former name. Of late years, however, the distinctness of the blaaubok has been fully recognised by naturalists; and Mr. Graham Renshaw, in the December number of *The Zoologist*, has done good service in collecting all the available evidence concerning the extermination of this interesting species, and in putting on record the specimens known to be still in existence. The blaaubok, it appears, was always restricted to a small area in South Africa, and appears to have been killed out in 1800. There are several mounted skins preserved in different museums, but none, unfortunately, in our own national collection.

At the meeting of the Zoological Society, held on 17th December last, Mr. G. Metcalfe expressed his opinion that naturalists are incorrect in stating that the Australian duckbill really lays its eggs. He believed, after many years' observation, that this remarkable mammal is viviparous, instead of, as generally believed, oviparous. So far as we are aware, there is no published account of the eggs of the duckbill having been actually taken from the nest in the burrow; but the late Mr. J. D. Ogilvy in his "Catalogue of Australian Mammals" (1892) makes the definite statement that two eggs are laid there. Now that the question has been raised, it may be hoped that the matter will be thoroughly thrashed out.

The Zoological Society have sustained a serious loss by the death of their immature male giraffe, which took place on the ninth of January. This animal, which was purchased for a large sum in 1899, was afflicted with a "kink" in the neck, doubtless the result of an injury received at or about the time of its capture; the marvel is that it did not die at a much earlier date.

The following important message was recently received from Major Ross, now investigating malaria and other diseases on the West Coast of Africa:—"I have much pleasure in informing you that Dr. Dutton has made a very important discovery at Bathurst. He has found a new kind of parasite which causes fever in human beings. The parasite is like the one which causes the fatal tsetse fly disease among horses in South Africa."

An excellent idea in the way of zoological gardens has been started at Parà, Brazil, in connection with the well-known museum so ably directed by Dr. E. Goeldi. Instead of buying foreign animals, the plan adopted in these gardens is to collect only those inhabiting Brazil. By this means, not only do the people learn to know the fauna of their own country, but important information with regard to the same will almost certainly accrue to science. Among other animals, a manati has been exhibited.

In an important paper by Mr. W. P. Pycraft, recently published in the *Journal* of the Linnean Society, the author shows that the bony palate of the Ratitæ, or ostrich-like birds, differs essentially from those of the Carinatæ (we see no reason to follow Mr. Pycraft in changing these familiar names) in several very important particulars. It is also shown that the ratite type of palate (which also occurs in the tinamus) is the older. Hitherto it does not appear to have been recognized that the palates of all Carinatæ differ in one and the same particular from that of the Ratitæ, but this the author demonstrates to be the case. He also shows that the most primitive type of carinate palate is that of the fowls, and the most complex that of the ducks, owls, and certain other groups. This complex (desmognathous) type of palate, he suggests, may have been acquired independently in two or more groups of birds, and is not therefore indicative of genetic affinity. This paper is one of the most valuable contributions to avian morphology that has appeared for some time.

THE NOBODIES,—A SEA-FARING FAMILY.

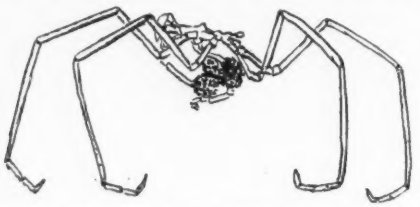
By Rev. T. R. R. STEBBING, M.A., F.R.S., F.L.S.

CHAPTER I.

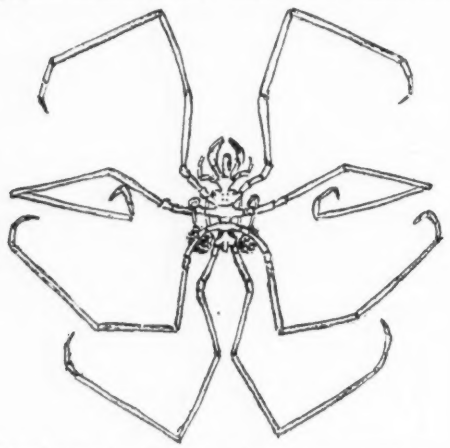
BEFORE boring out the eye, the solitary eye, of the stupefied Cyclops, Odysseus, in the Odyssey, took the precaution of stating that his own name was Outis, or Nobody. When the cruel cannibal, awaking to blind fury, shouted for vengeance, his neighbours were not a little mystified to hear that the outrage had been wreaked upon him by Nobody. They accordingly dispersed without attempting to catch Nobody, or put Nobody to death. Eventually, as we know, the so-called Nobody escaped by the skin of his teeth, and the story of his adventures has not ceased to fascinate the world during far more than two thousand years. In the economy of nature there occur bodies without limbs, bodies without apparatus for feeding, and occasionally limbs capable of detachment from bodies without loss of their own life and functional activity. But, strictly speaking, animals without bodies are unknown to zoology. All that can be said for the family now to be discussed is that they make an uncommonly good attempt to supply the deficiency. Socially we apply the term "nobodies" to persons who are unclassed, whose names never come before the cultured public, whose origin, qualities, and mode of existence are so little or so vaguely known that they neither attract the attention nor influence the thought of the world. In this sense also the group of marine animals now suing for notice justifies the modest title under which it is led on to the stage. Were it something absolutely novel, it might be brought forward with circumstantial pomp and a flourish of trumpets. It is too late for that now. Ström had a chance a hundred and forty years ago of exulting over his *Phalangium marinum* and *Phalangium littorale* as exceptions to the axiom that "there is nothing new under the sun." But he missed his chance by the very fact of assigning his discoveries to the genus *Phalangium*, thereby identifying them with the tracheate arachnids, popularly known as "harvestmen," a long-legged terrestrial tribe, peculiar indeed, but not new. That Ström was not able accurately to classify creatures, which had a familiar look of being honest harvestmen, but belied their looks by living in the sea or clambering about between tidemarks, was really not any discredit to Ström. A thin stream of highly capable observers since his time have busied themselves with the same creatures and their kindred. They have studied many species. They have founded numerous genera. They have assigned the whole group first to one zoological class and then to another with a persistency of irregular oscillation that no pendulum could imitate. The end of it all is very like the beginning, the result being that, place the group where you will in accepted orders, it is only by force and not by fitness that it can be pushed in. Such is the isolated and problematic position of the Pycnogonida.

XUM

It would be absurd to say that these animals are popularly known as sea-spiders, since there is really no popular knowledge concerning them. Vernacular names of



Nymphon marinum (Ström). Natural size. Lateral view.



Nymphon marinum (Ström). Natural size. Dorsal view. After E. B. Wilson *

this kind obtain a certain currency, because in regard to things strange and unaccustomed we are always longing to be able to speak and to hear every man in the tongue wherein we were born. But in the expression "sea-spiders" there is the special disadvantage that it prejudges a case which is still being argued. Though they are certainly not spiders, the question remains open whether their relationship to spiders is too remote to admit of their being grouped anywhere near them, or along with them at all, in the Arachnida. Their scientific name is properly derived from the earliest genus established in the group, *Pycnogonum*, Brünnich, 1764, and simply refers to a striking external characteristic, the "frequent angles" which their structure in general, and their limbs in particular, display. The Arthropoda, that vast division of the animal kingdom, which includes our present group along with Crustacea, Arachnida, Myriopoda, and the uncounted legions of the Insecta, are named from the common character of "jointed legs." In the Pycnogonida more uniformly than anywhere else is the significance of this name "arthropod" justified. For here the legs are the predominant structures in the organism, and their geniculations are as obtrusive and pertinacious as in any harlequinade. So decided is the prominence of the legs that in the early part of the nineteenth century Dr. Leach named the tribe Podosomata, meaning leg-bodied animals, and in the later part of the same century Gerstaecker and Dr. Anton Dohrn adopted for them the name Pantopoda, meaning animals that are all legs or nothing but legs. These designations, therefore, come to much the same thing as saying in English that the animals have no bodies.

* This species is commonly called *Nymphon strömii*, Krŏyer; its identification with Ström's species being more or less conjectural.

That, however, is by no means literally true, and accordingly there is no scientific warrant for displacing the earlier name Pycnogonida introduced by Latreille.

Dr. Dohrn in 1869, fresh from studying the group at Millport, in the island of Cumbrae, declared that, speaking generally, all English zoologists at that time considered it to be of crustacean nature, and that with equal unanimity all German zoologists referred it to the spiders. As a matter of history, then, it is worth while recalling that in the first volume of our English *Zoological Record*, which is the volume for 1864, Mr. Spence Bate writes of the "Pycnogonidae" as follows: "In adding this family to those of Crustacea, we do not consider that we are pledging ourselves beyond identifying it as a link that connects the Crustacea with the Arachnida. Although the result of recent research, both in the structure and development of these animals, tends to place them among the Arachnida, there are some points in their structure that associate them with the Crustacea; this, together with old association, induces us to speak of them in this place for the present." This old association may refer to the work of Johnston in 1837, and of Goodsir five or six years later, but Leach in 1815, in a famous contribution to the *Transactions* of the Linnean Society, most expressly includes the present tribe in the Arachnida, and Adam White, in 1857, excludes it from his "History of British Crustacea." Moreover, in the volumes of the *Zoological Record* the esteemed German writer, Dr. von Martens, who succeeded Spence Bate as recorder of crustaceans, followed his example down to the year 1874. There is, therefore, no such Anglo-Teutonic cleavage of opinion as Dr. Dohrn supposed. Much rather are two illustrious French authors mainly responsible for upholding the crustacean affinities of these spindle-shanks. For a long time the "Histoire Naturelle des Crustacés," by Henri Milne-Edwards, deservedly held the field as the only moderately complete, comprehensive, and trustworthy history of that class. During its reign there would have been few desirous, and still fewer effectively capable, of disputing the historian's opinion on an obscure issue which is thus expressed in his third volume (1840):—"It is only with much hesitation that I place here a little group of articulated animals which have been considered by most zoologists as belonging to the class of Arachnida, but which seem to me to have more analogy with the Crustacea, for they have no tracheæ nor lung-books for atmospheric respiration, and they do not appear to breathe the oxygen dissolved in water except through the general surface of the skin, as we have seen to be the case in several lower crustaceans." Much earlier, in 1816, Jules César Savigny, in his striking essays on Invertebrata, stoutly argued that, if the group were not actually crustacean, it was the link which most certainly connected that class with the arachnids. In those essays Savigny had at least one memorable success, namely, that which attended his homologizing, as it is called, the limbs of the Malacostraca. He demonstrated that the very organs, which in one set of them are parts of the mouth-apparatus and concerned with feeding, or, in one word, are jaws, in another set are prehensile or ambulatory limbs, answering to the description not of jaws but of arms or legs. One need not perhaps be surprised that he attempted to extend this discovery in other directions, and hoped to find in it a key for solving fresh problems.

Savigny was very well aware that in the Pycnogonida, when they are most fully furnished with appendages, there are never present more than seven pairs, whereas in the Malacostraca when fully furnished these pairs amount to nineteen, without counting the stalked eyes. This being so, he was under much of an obligation to compare a

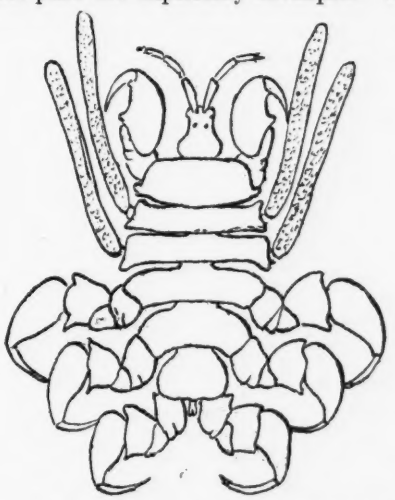
fully-furnished pycnogonid with a malacostracan not fully furnished. Yet to this convenient procedure he was led probably less by his own acuteness than by the odd behaviour of some earlier naturalists.

So long ago as 1675 the little amphipod, now known as *Cyamus ceti* (Linn.), which nibbles the skin of the Greenland whale, was described and rudely figured by one Friderich Martens, who evidently had in him the making of a good naturalist. Though vulgarly called a whale-louse, the *Cyamus* is as true a malacostracan as any crab or lobster. But it has its own features of distinction. Among the amphipods it belongs to that section called Caprellidea, which have so little of the roving disposition that they have found it convenient to dispense with pleopods or swimming feet. As a corollary to this act of abnegation they have reduced the pleon (or abdomen), which elsewhere carries the pleopods, to little more than a vestigial stump or reminiscence. On its head *Cyamus* carries a pair of simple eyes, and on its trunk or middle body instead of the normal seven pairs of legs it has but five pairs, the third and fourth having dwindled away to mere attachments for the branchiæ and the female brood-pouch. Now in 1765 Job Baster, a Dutch enthusiast on the botany and zoology of the day, called attention to this *Cyamus* in a singular manner. He was writing of fish-lice, and after remarking on the horror which many persons feel at the second half of that compound word, he adds that "a naturalist, on the other hand, who can never think it undignified to examine what God has not thought it undignified to create, finds tokens of the divine wisdom, power, and providence, as well in the despised louse as in the great elephant or rhinoceros." That is written in the spirit of a philosopher. But later on he makes particular observations which became the source of prolonged confusion. He describes and figures a pycnogonid, for some inscrutable reason introducing it as a whale-louse, though he does not pretend to say that he obtained it from a whale. Indeed, he recognises its essential distinctness from the original whale-louse described by Friderich Martens, but accuses Linnæus of having considered them one and the same. Linnæus, in his attempt to embrace the whole world of natural history, no doubt committed many errors, but this particular one was plainly out of his reach. The part of his tenth edition, in which according to Baster he made it, was published in 1758, while the Pycnogonida, as already explained, were not known before 1762. Still, as everyone is aware, Linnæus was a man of very obliging temper, and accordingly in 1767 he actually did commit the fault of which he was falsely accused in 1765. In his twelfth edition he makes Martens' whale-louse a synonym of Brünnich's *Pycnogonum* under the title of *Phalangium balænarum*, and this specific title is retained even in 1794 by J. C. Fabricius, although it had no claim to supersede Ström's earlier *littorale*, and although the Pycnogonida have nothing to do with baleen whales or any others.

Cyamus ceti (Linn.). After F. Martens.

Pycnogonum littorale (Ström). After Brünnich.

In whatever mistakes it may have originated, the coupling together of *Cyamus* and *Pycnogonum* made a comparison between the two a task as it were marked out and prepared for Savigny's hand. In the latter genus there are four simple eyes; in the former there are only two, but Savigny found in addition two compound eyes, which no other naturalist has seen before or since, and strangely enough the critics appointed to report on his essay, though evidently not at all disinclined to find faults in it, credit him with this imaginary discovery as something of considerable importance. For some reason he does not lay any special stress upon it himself. To compensate for this self-denial he makes the extraordinary observation that "Crustacea have not, properly speaking, any abdomen, and the Pycnogonid group are distinguished from other Arachnids by the length of their thorax and the extreme smallness of their abdomen." It is true that the Caprellidea have the abdomen singularly reduced, but in this respect they are exceptional not only among the Amphipoda but among all Malacostraca, and not only among them but among all free-moving crustaceans. To say that a lobster, for example, has no abdomen, so far from speaking properly, would be to make a statement as absurd as could well be devised. Savigny, however, was chiefly concerned to establish a parallel between the appendages of the trunk or thorax in the two animals under comparison. In an amphipod or isopod, the cephalic division or "head" carries six pairs of appendages. Then comes the trunk with seven pairs, which are all faithfully represented in *Cyamus*, though in a dorsal view the first pair are not seen, being concealed under the second, and, as previously mentioned, the third and fourth pairs are imperfectly developed. With this



Cyamus ceti (Linn.). Magnified. After Lütken.

state of things Savigny compared a species of *Nymphon*, in which he maintained that the cephalic part, or head, was constituted only by the proboscis, devoid of any distinct appendages, and that the seven pairs attached behind the proboscis answered to the seven pairs of limbs in the trunk of an amphipod. That in some of the Pycnogonida the first, the second, and in one sex the third, of the seven pairs may be wanting, is no impediment to Savigny's hypothesis, since in *Cyamus* also, two of the pairs have suffered degradation, and in both the compared groups abdominal limbs are, as a rule, conspicuous by their absence. But since the mainstay of Savigny's comparison is the numerical fact, that in each case the middle-body of the animal normally carries seven pairs of appendages, it becomes apparent that the comparison is definitely tied to the Malacostraca, among which alone that numerical arrangement is found. In

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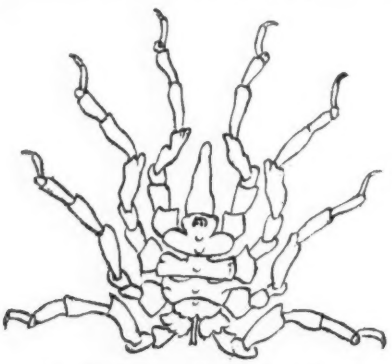
the Malacostraca, however, there is no approach to a proboscidiform head, nor are heads to be found entirely devoid of appendages. Such a state of cephalic destitution does not occur even in the degraded parasitic isopods, and if it did, these as well by their life as their limbs are removed from comparison with the Pycnogonida. Again, the Malacostraca never have the eyes planted anywhere



Pycnogonum littorale (Ström). Magnified. After E. B. Wilson.

but upon the head. The eyes may be stalked or sessile, separate or united, compound or simple, or mixed of both, or they may be altogether absent, but they are never under any circumstances placed upon the thorax, which according to Savigny's interpretation is their position in *Nymphon* and its allies. The presence of external branchiæ, as found in the Malacostraca, in contrast to the total absence of branchiæ from the Pycnogonida, is set aside by Savigny as a difference of trifling importance. But the puny abdomen which is common to the Caprellidea and the Pycnogonida really narrows down the applicability of his comparison to the amphipods, since these are the only malacostracans among which the degraded abdomen occurs, and all these have external branchiæ on the thorax. The four hinder pairs of legs in the Amphipoda present numerous diversities of shape, but through them all they take care in their articulation never to exceed the limit of seven joints. With equal fidelity the Pycnogonida in their walking limbs take care to exceed that number. It would certainly seem, therefore, that from almost every point of view, Savigny's attempt to homologize the Pycnogonid limbs with those of the Crustacea, was a failure. It took its rise apparently from Baster's verbal mistake in calling a *Pycnogonum* a whale-louse, it was fostered by a certain superficial resemblance between two quite different animals, and it was developed through over-eagerness to make one triumph of ingenuity lead on to another.

From this historical and controversial discussion some facts relating to the structure of our "nobodies" will have been gleaned. There are rather singular details to be recounted hereafter.

Notices of Books.

"MAN."—The most generally interesting item in the January issue, which commences a new volume, of this excellent anthropological journal, is an illustrated article by Prof. E. B. Tylor on a "totem-post" from Queen Charlotte Island, British Columbia, recently erected in the Pitt-Rivers Museum at Oxford. The post, in its present condition, is a little over forty feet in height, and is appropriately placed between two "house-posts," which came from the same village, if not from the same house. A photograph of the Haida village of Masset shows a row of these totem-posts (among them the Oxford specimen) before the chiefs' houses. "No more posts," writes Prof. Tylor, "are likely to be set up at Masset. Missionary influence has impressed on the native mind a sense of such art being a waste of labour." It is, therefore, well that this fine example has been secured in time. The exquisite coloured plate shows in detail the elaborate carving and colouring of the crown of the post; the "totems," or figures, being those of the family of its original owner. Other articles in the same number deal with the practice of altering the shape of the head among certain Pathans in the Punjab, Burmese pipes, Irish folk-lore, etc.

"THE EARTH'S BEGINNING." By Sir Robert Stawell Ball, LL.D., F.R.S. (Cassell.) Illustrated. 7s. 6d.—Sir Robert Ball is always interesting, and not least so when he is lecturing to children. The present volume is the result of his juvenile lectures at Christmas, in 1899-1900, in the Royal Institution, thrown into book form, and form a popular exposition of Laplace's nebular hypothesis, in which Laplace's theoretical reasoning is touched upon very lightly, and more fully the evidence in its favour afforded by the photographs of nebulæ and star clusters, taken in America by the Lick and Yerkes Observatories, and in this country by Dr. Isaac Roberts and Mr. W. E. Wilson. The book is very fully illustrated, two of the pictures of Krakatoa, and of its effects on an English sunset, being highly coloured. We could have wished, however, that the pictures had not been printed in the text, but had been given as plates on separate pages, without printing or illustration on the back. The first paragraph suggests that Sir Robert had sat at the feet of Lord Rosebery when he gave his astronomical speech at Birmingham in October. Does Sir Robert really find from personal experience that "temporary concerns" (such as toothache or influenza) are forgotten in the presence of such phenomena as a spiral nebula, or in the contemplation of the solar evolution from the primeval fire-mist? And does Sir Robert really mean to give the impression that the nebulæ that Dr. Roberts has photographed in Pisces, or Coma Berenices, or Ursa Major, are such systems even as the Milky Way, only writ small since they are so distant from us and from it? Surely this is but the heresy of the "1500 universes" which Sir William Herschel described to Miss Burney as "whole sidereal systems, some of which might well outvie our Milky Way in grandeur," the heresy of which his later knowledge made him recant.

"ANTICIPATIONS OF THE REACTION OF MECHANICAL AND SCIENTIFIC PROGRESS UPON HUMAN LIFE AND THOUGHT." By H. G. Wells. (Chapman & Hall.) Price 7s. 6d.—Of the many hundreds of books published in the course of a year, it is not often possible to name more than five or six which force themselves upon the attention of thoughtful readers of all classes. One of these select volumes from the literary output of 1901 is Mr. Wells's "Anticipations"; and we do not hesitate to say that no more vigorous and stimulating statement of human affairs and destinies has been published for some time. The author is best known perhaps by his fantastic stories, in which many scientific readers have found delight, and failed to find the paradox of the central idea. In this volume we have him as a philosopher, oracle, and prophet, who, surveying existing customs and social relationships, relentlessly points out the shams, pronounces the doom of stupid methods and conventionalities, and predicts the condition of things at the end of this century. It is impossible in the brief space which can here be devoted to the book to describe even in outline the social analysis and synthesis elaborated by Mr. Wells; but we can indicate the line of argument. Take, for instance, the subject of locomotion of the present and future. Now we have the crowded, slow, uncomfortable, unpunctual trains, which, in the case of London suburban traffic, traverse about twelve miles in an hour, and make it impossible for men with business in the city to live far out in the country. Leaving aerial navigation out of the question, it is suggested that the development of locomotion will probably be in connection with automobiles running on specially prepared tracks. Carriages of this kind will enable people to get out of town quickly, easily, and without the necessity of departing from one particular station and being carried to another, which may or may not be close to the desired destination. Horse traffic is a means of locomotion which is unworthy of an enlightened generation; for besides being inefficient, it is destructive and defiling to the streets. With the growth of motor tracks, the radius of a city will be greatly extended, and telephonic communication will enable all

parts of the country to be connected for speech. Mr. Wells says nothing about automatic telephone exchanges or the possibility of telephony without intervening wires, but the changes he foreshadows will not be affected by developments of this kind. He is, in fact, more concerned with the effects of invention and increased knowledge upon the social organism than with future mechanical accomplishments. He predicts the downfall of Democracy and the creation of a New Republic in which the engineering and scientific class will exert dominant influence. The present order of things will pass away, and in the new heaven and new earth which Mr. Wells forecasts intellect will reign supreme. The author is no mere iconoclast, but an acute observer who examines the stream of tendency from many points of view and describes how use may be made of its flood. His conclusions will not be accepted by all students of human nature, but every reader of the book will be influenced by its forcible argument. Using the material available he establishes the New Republic about the year 2000, but knowing something of social inertia we suggest that two or three thousand years later would be nearer the epoch of the millenium. Mr. Wells' book appeals to every thoughtful mind, and, we believe, it will have a decided influence upon the trend of social evolution.

"LAST WORDS ON MATERIALISM AND KINDRED SUBJECTS." By Prof. Ludwig Büchner, M.D. With a life of the Author by Prof. Alex. Büchner. Translated by Joseph McCabe. (Watts.) 6s. net.—The title of this book is an unfortunate one. Prof. Büchner was not a materialist. He insists, again and again, in these essays that the system of thought he advocated is more accurately described as monism. The fact is there are no materialists. The beginning of the new century sees two opposing schools of thought; on the one side are the monists, with whom Ludwig Büchner would be found were he still alive, and on the other, are the dualists. Moreover, so long as the inorganic world alone is under consideration there is, to all intents and purposes, no difference between the monist and his opponent. When, however, the phenomena of life and consciousness call for explanation the difference between them is clear enough. The monist recognises no break between the inorganic and the organic worlds; the great principles of the conservation of matter and energy, and the other laws of physical science, are, he urges, as true of living things as any others. The dualist, on the contrary, maintains that satisfactorily to explain the organic world it is necessary to postulate a second cause, an effect of which when we come to study man, is found in his "soul." It is hardly necessary to remind readers of KNOWLEDGE that a large number of men of science are monists. As to the ultimate cause of all existence the man of science knows nothing, nor indeed does there seem any possibility of his knowing. Mr. Herbert Spencer has, to questions of this sort, given the name the "unknowable." But the great fact for practical men is that the "unknown" and the "unknowable" are by no means synonymous. With the triumphant march of science the "unknown" is every day having to reduce its boundaries, and this is incentive enough for the man of science. There has been in the past an opprobrium attaching to the name materialist, due probably to the uneducated advocacy of men who were concerned less with the advance of scientific knowledge than with the overthrow of dogmatic theology. The name might very well be allowed to die; and, if at the same time, those who find no need in the universe for any dualistic hypothesis are content simply to try to advance natural knowledge and to leave religious systems to take care of themselves, we shall be saved much useless controversy and have energy to spare for more important work. The world is fortunately beginning to understand that the practical matter of conduct is influenced much less by dogmas held on faith than was originally thought. To return to Mr. McCabe's translation, it is on the whole well done, though we think it is a pity that somebody conversant with technical terms did not revise the translation. Had this been done we should not have to call attention to such irritating mistakes as "phosphor" for "phosphorus" (pp. 41-2), "corbonic" for "carbonic" (p. 50), "sulphuretted antimony" (p. 32), and so on.

"LECTURES AND ESSAYS." By the late William Kingdon Clifford. In two volumes. (Macmillan.) 10s.—The addition of these lectures and essays, first published in 1879, to the widely popular Eversley series will give the younger generation of students of science who are unfamiliar with Clifford's views, an opportunity of benefiting by these remarkably lucid expositions of fundamentally important subjects and of making the acquaintance of two beautifully produced volumes. As Sir Frederick Pollock says in a biographical preface, Clifford "expressed his own views plainly and strongly because he held it the duty of every man so to do; he could not discuss great subjects in a half-hearted fashion under a system of mutual conventions." He always discussed metaphysical and theological problems with exactly the same freedom from preconceived conclusions and fearlessness of consequences as any other problems. He always went to the root of matters under consideration. Taking as his subject ordinary questions of everyday life, on which all men ponder, he would so probe and analyse them that his hearers understood before he had finished that, having obtained clear views on the simple affairs of conduct and belief, they were well on the way to grasp all the philosophy that really concerned them. "Body and Mind," "Right and Wrong," "The Ethics of Belief," are examples of the questions that Clifford loved to explain to intelligent audiences. "The domain of science," he said on one occasion, "is all possible human knowledge which can rightly be used to guide human conduct." No bounds must be set to the "purifying and organizing work of science." It is not surprising that so fearless a thinker and so brave a prophet was often disliked and dreaded. Naturally, the doctrine that "it is wrong in all cases to believe on insufficient evidence; and where it is presumption to doubt and investigate, there it is worse than presumption to believe"—did not endear Clifford to official theologists. But the more intelligent views which are common to-day are to be traced to men like Clifford, who, regardless of what pleased this or that sect, preached truth for truth's sake, and maintained that all truth is the heritage of humanity and must not be withheld because priests and church officials say the masses cannot bear it yet. The young student of science, nurtured in orthodoxy, who is finding himself in pain and travail as he first applies the scientific method to the dogmas he was taught in childhood, should read and study these essays. Here are the words of a master who has passed along the same road, who though he discarded many of the myths of the infancy of the race, never lost his grasp of the great ethical and moral principles on which the social welfare of mankind will always depend.

"STUDIES IN HETEROGENESIS." By Prof. H. Charlton Bastian, M.A., M.D., F.R.S. First Part. Illustrated. (Williams & Norgate.) 7s. 6d.—The conclusions arrived at by Prof. Bastian are so opposed to the teachings of modern biologists that we cannot but be surprised at their enunciation by a Fellow of the Royal Society. The thesis which he endeavours to establish is, in general terms, that from one presumably pure substance of an organism it is possible to produce various alien forms of life. In support of this view, among other observations described and illustrated, are the transformation of the contents of vegetal cells and organisms into such forms of life as amœbæ, actinophrys, and monad cysts; of the substance of certain encysted ciliates into amœbæ and monads; and of the substance of the eggs of certain rotifers into primitive fungoid sporangia and ciliated infusoria. The natural interpretation to put upon the observations would be that the changes described are due to the multiplication of forms of life of which the germs existed in the original substance, or which invaded it. Prof. Bastian has considered this interpretation but has rejected it in favour of the conclusion "that the resulting forms of life are, in reality, heterogenetic products originating from the very substance of the organisms or of the germs from which they proceed." Such a heterodox opinion is not likely to be accepted upon the evidence he brings forward, but to disprove it would be as difficult as it was to overthrow the doctrine of spontaneous generation. The subject can only be dealt with adequately by biologists trained in the exact methods used by Pasteur and his followers, and we believe they would object to the conditions under which many of the observations were made.

"A READY AID TO DISTINGUISH THE COMMONER WILD BIRDS OF GREAT BRITAIN." By David T. Price. (Gurney & Jackson).—In this little book the author has made a poor attempt to carry out an idea which would be of value if it could be successfully accomplished. Mr. Price begins with a sort of key by which on seeing a bird in the garden, field, or wood, one is supposed to be able to judge its species. For this purpose a much more exact and more wisely arranged key than that

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devised by the author would be necessary to lead to a correct identification. Having discovered, by the key, the supposed name of the bird seen, we are referred to a brief description of it in the second part of the book. Here Mr. Price has come sadly to grief regarding many species. His idea has been to deal with "habitat, flight and characteristic habits rather than details of plumage." Then why does he not, for instance, differentiate the brown and barn owls by their distinctive notes rather than by the colour of their plumage, which is seen rarely when they are abroad? Some of the author's descriptions are very good, and in these the correct characteristics in habits or plumage which will lead to identification have been pointed out. But Mr. Price is evidently a poor observer, and in many instances shows a lamentable want of knowledge of his subject. He says, for example, that the cock house sparrow has a red-brown cap, and surely of all birds the familiar sparrow could have been described correctly. That the red-brown cap belongs to the tree-sparrow, and is one of its distinguishing marks is not mentioned. Again the plumage of the wheatear is described as pale brown. The female wheatear, and even the male in early winter, may be so described, but the conspicuous and beautiful grey of the cock bird in spring and summer is not referred to. Nor do we think the author's selection of the commoner birds altogether wise. The guillemot, for instance, is described; but the razor-bill, which in winter, in any case, might easily be mistaken for it, is ignored.

BOOKS RECEIVED.

Text-Book of Elementary Botany. By Charlotte L. Laurie. (Allman & Son.) Illustrated.

Experimental Chemistry. By Lyman C. Newell, PH.D. (Heath.) 5s.

"Stops": or How to Punctuate. By P. Allardyce. (Fisher Unwin.) 1s.

Britain and the British Seas. By H. J. Mackinder, M.A. (Heinemann.) Illustrated.

Lamarck: His Life and Work. By Alpheus S. Packard, M.D., LL.D. (Longmans.) 9s. net.

Concise Dictionary of Egyptian Archæology. By M. Brodrick and A. Anderson Morton. (Methuen.) Illustrated. 3s. 6d.

Mosquito Brigades and How to Organise Them. By Ronald Ross, F.R.C.S., D.P.H., F.R.S. (George Philip & Son.) 3s. net.

Guide to the Practical Elements of Electrical Testing. By J. Warren. (Rentell.) Illustrated. 3s. 6d.

Practical Electrician's Pocket Book and Diary, 1902. (Rentell.) 1s.

French History, 1815–1873. By Henry Hirsch, B.A. (Blackie.) 1s. 6d.

History of Geology and Palæontology. By Karl Alfred von Zittel. Translated by Maria M. Ogilvie-Gordon. (Walter Scott.) 6s.

In Memory of W. V. By William Canton. (Dent.) 3s. 6d. net.

Discussion on the Teaching of Mathematics. (British Association.) Edited by John Perry. (Macmillan.) 2s. net.

Annuaire Astronomique et Météorologique pour 1902. By Camille Flammarion. (Paris: Ernest Flammarion.) 1 fr. 25.

Underground Watering of Plants and Gardens. By John Grant. (Ward, Lock.) 1s.

Bird-Killing as a Method in Ornithology. By Reginald C. Robbins. (Cambridge, Mass.: Wheeler.)

THE FLIGHT OF A HAILSTONE.

By ARTHUR H. BELL.

A HAILSTONE, when dissected, is found to be an aggregate of tiny crystals disposed in concentric rings or zones; zones which, if rightly cross-examined, will have much to tell concerning the wonderful journey of the hailstone as it plunged through the atmosphere on its way to the earth. A snowflake makes this same journey through the air in a more leisurely fashion, and it does not arrive at its destination with the noise and rattle that announces the descent on the earth of hailstones; but the two travellers are very nearly related, for they are both the offspring of aqueous vapour. It is part of the work of the meteorologist nowadays to discover, if he can, why the moisture in the air sometimes takes the form of a snowflake, while at others it crystallizes as a hailstone. To merely record the size of a hailstone is insufficient, for these frozen pellets of moisture have more interesting attributes.

At the heart of every hailstone is a tiny atom of dust, which may be considered to be the very foundation of the whole icy structure. These atoms of dust pervade every part of the atmosphere. Not only are they found in the lower strata of the air, but the winds carry them far above the highest mountains, and no matter whether samples of air obtained by balloonists or by mountain travellers are examined, minute particles of dust are always everywhere to be found. Indeed, it is becoming understood that without an atom of dust upon which the moisture of the air could settle there would be no rain-drops, no snow, no fog, dew, clouds or hail. Without these minute platforms, as they may be called, upon which the moisture as it condenses could alight, rain would be continually pouring down upon the earth, and it is these motes that keep the moisture buoyed up in the atmosphere until such times as circumstances compel them to yield up the aqueous supplies which they so industriously collect. Supposing, then, that a little vapour should happen to condense on a particle of dust floating aimlessly through the air, there is a beginning made of what, under favourable conditions, may ultimately grow to a full-sized hailstone.

It is highly probable that, for a hailstone to have fitting opportunity of growing to maturity, it must take its plunge to the earth from a great height. The clouds which float at the greatest distance from the earth are those known as the cirrus, which are often seen many miles above the tops of the highest mountains. If, then, an incipient hailstone can only dive towards the earth from this dizzy height it will in its headlong flight pass through strata of air differing very much as regards moisture and temperature, and these are the circumstances most favourable to its development.

But before the growing hailstone can launch itself downwards it must by some means or other contrive to get itself carried up to these serene and chilly heights. Briefly, it makes the journey by stepping, as it were, into one of the strong ascensional currents of air which spring upwards from almost every part of the earth's surface. These currents are revealed by the cumulus clouds which are but the visible tops of columns of air. As these rising currents of air rush upwards they presently arrive at a height where the air is rare and cold, so that the aqueous vapour they carry with them condenses and promptly assumes the form of a cloud; a process that may be likened to a rocket which bursts into a visible cloud of fire at the end of its upward flight. If, then, the dusty atom with its tiny load of moisture that is subsequently to form the nucleus of a hailstone can succeed in entering such a rising stream of air it will ere long find itself at a height that will ultimately prove to be an admirable coign of advantage. In this position it resembles nothing so much as an oak apple dancing at the top of a jet of water, for in each case an ascending current keeps the object buoyed up.

But it often happens that yet loftier heights are necessary for the growth of a hailstone. Supposing, then, that a further upward flight is desirable, there is a convenient motive force ready to hand. It is well known that whenever condensation of moisture takes place latent heat is set free, so that when the aqueous vapour is actively engaged, say, in condensing into the form of a cloud, it is probable that great supplies of warmth spring into being. This warmth, of course, raises the temperature of the air, and as the latter becomes warmed it rises and another form of ascending current is thereby produced. Such a current provides the hailstone with a means of conveyance to those exalted

regions it is so advantageous to reach. Probably at the end of its long journey the incipient hailstone will be far up in one of the cirrus clouds, surrounded by particles of moisture frozen by the cold rarefied air into ice crystals, so that in its new situation the hailstone would find ample supplies of the material so necessary for its growth.

In such company it is not long before the moisture on the atom of dust also freezes. The form which the frozen moisture will take depends on circumstances, but there are many possibilities before it. Thus it may crystallize as a tiny pellet of snow, or it may take the shape of an ice crystal, or it may commence as a snow-flake; while in certain circumstances it will simply take the form of a frozen rain-drop. Any of these shapes will serve as an excellent starting point from which to commence the earthward journey.

During all the time of its upward journey the force of gravitation has been steadily pulling at the rising atom of dust and its load of moisture. Few things floating in the air can long resist this imperative call to return to the earth.

Falling slowly downwards, the motion being slow at first because the bulk of frozen moisture is small, the hailstone at once commences to attract to itself other particles of frozen moisture. These adhere to it much in the same way that snow-flakes will adhere to anyone travelling quickly through a snow storm; so that as the hailstone pushes its way downwards it grows in bulk. Moreover, as its weight increases it may happen that its centre of gravity shifts, and it becomes accordingly of an irregular shape. This accident indeed accounts for many of the curious shapes assumed by hailstones and gives them that peg-top shape which is so often observed. It is to be remembered also that a hailstone takes a long time to drop from the clouds to the earth, it being calculated that the journey may often occupy ten minutes. In this interval most of the transformations occur that produce the full-grown hailstone.

Imagining now the journey to be well started it will at once be realised that the travelling hailstone will pass through strata of air that differ very much as regards temperature and moisture. Some of the air will be above the freezing point and other layers will be below it; while it will be no uncommon episode for the dropping hailstone to plunge sheer through a cloud that may be many thousands of feet thick. The hailstone itself, with its heart of ice, is always below the freezing point, so that any moisture that settles on it is promptly frozen and forms a girdle of ice around the central nucleus. An examination indeed of any hailstone shows that these icy girdles are its most characteristic feature. It will also be observed that these girdles or zones are of two kinds, and that they are alternately clear and opaque. It is these zones that tell the most concerning the incidents of a wonderful journey, for they are produced by the different strata of air through which the hailstone passed, each country, as it were, over which the journey was made impressing its characteristics on the flying traveller.

When the hailstone passed through air that was below the freezing point the moisture that settled upon it was frozen in the form of a clear zone of ice; while, on the other hand, when the air and its contained moisture were above the freezing point the girdle of ice was opaque.

A further important consideration as regards the hailstone is that moisture may often be reduced in temperature below the freezing point without actually congealing. It is a common experiment thus to treat moisture, but it is always found that the slightest agitation of this cooled liquid at once causes it to crystallize. When, therefore, the hailstones come pelting through air in this condition it will readily be understood that the commotion produces a plentiful supply of ice crystals, many of which are quickly annexed by the hailstones, which are thereby greatly increased in size.

The foregoing are the most common conditions that favour the growth of a hailstone, and it will be concluded that the essential conditions required are layers of air of different temperatures. Now it frequently happens that hail accompanies a thunderstorm or a tornado; these two phenomena being very nearly related. In both there is an atmospheric whirl, which, in the tornado, produces a strong wind that is commonly of a destructive character. If, then, a hailstone should be going through its evolutions in the neighbourhood of one of these storms it stands a good chance of being whirled round and round in the air, a process that may continue for a considerable time. This violent treatment, however, has the same effect as if the hailstone were falling downwards through the air, and the result is that it may be carried again and again through first a cold stratum of air and then through a warm one. As already seen these are the very conditions that favour the growth of hailstones, and hence it is that hail so commonly accompanies thunderstorms, tornadoes, and such like atmospheric disturbances.

The whirling of hailstones through the air cannot, however, continue indefinitely, for presently they grow so heavy that they fall in a rattling stream from the edge of the cloud. Observation shows that hail showers often pass across the country in parallel lines; but it will be gathered that this is owing, as described above, to the fact that the stones are ejected from the sides of the storm cloud and not so much from its centre. Hailstorms, as a rule, are not of a very large area, and are much longer than they are wide. The width is regulated by the dimensions of the cloud, the length being governed by the distance to which the internal energy of the storm urges the storm-cloud forward.

Hail occurs more frequently during the day than in the night, and in summer than in winter. It also falls more copiously over the land than over the sea, where it is but rarely observed. Hail, indeed, is a turbulent child, and it does best in those localities and at those seasons when the atmosphere is in a variable mood. At such times the cross currents in the air produce those eddies which are the most favourable for the growth of storm-clouds, out of which leap the tornado and the thunderstorm. Plains also are more often visited by hail than mountainous regions, for here again the atmosphere is more likely to be in an unstable condition because such exposed ground often varies greatly in its temperature. Hail, moreover, is rarely met with in the Arctic regions, thunderstorms being equally rare in this locality. It is this circumstance, among others, that has caused some people to give atmospheric electricity a prominent position in relation to hail formation, and more especially so because lightning and hailstorms frequently occur together. Caution, however, is always necessary when putting electricity forward as a cause, for to do so is often to explain one mystery by another. From what has been said it will be gathered that there are simpler explanations of the flight of a hailstone, and it is along these more obvious lines that the history of this interesting phenomenon is nowadays being studied.

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COLLECTING AND PREPARING FORAMINIFERA.

By A. Earland.

(*Continued from p.* 21.)

The residuum which had been set aside in a jar may now be treated by the "rocking" process, for the separation of the remaining Foraminifera. Taking the photographic developing dish, or a tin tray may be used as a substitute, enough of the residuum is placed in it to cover the bottom to a depth of about ¼ inch, and covered with about ¾ inch of water. If the dish is then rocked with a combined up and down and circular motion, the Foraminifera will rise in suspension in the water, and by a little careful manipulation may be gathered in one corner of the dish. A sudden tilt will then empty them with the water into a sieve. The operation should be repeated with two or three lots of water, and the material left in the dish will then be found to consist almost entirely of sand. The material left in this second sieve, known as "washings," is not so pure as the "floatings," for it contains a large percentage of broken forms and shell fragments, coal dust, and other *débris*. It may be further purified, if desired, by being dried and "floated" once or twice in the glass jar.

If the floatings thus obtained contain much animal or vegetable matter, as is sometimes the case, it is advisable to boil them in a solution of caustic potash. This will not damage the Foraminifera so long as the boiling is not carried on too long, and it effectually removes the animal matter, which otherwise would encourage fungoid growths.

The processes already described are intended for recent *sandy* gatherings. When the material is in the form of dredged mud, it is first necessary to get rid of the finest particles of this mud, for if the water is turbid it becomes very difficult to judge the right moment for separating the floating Forams. The mud should be broken up into small lumps, about an inch cube, and slowly but thoroughly dried. It is then placed in a basin and covered with water, which rapidly breaks it up into a fine mud. Such specimens as may be observed floating on the surface of the water may be easily removed by means of cigarette papers, which are placed on the surface of the water. The Forams adhere to the papers, which are then carefully lifted off and dried, the Forams being then brushed off into a tube. Many delicate forms, which would almost certainly be broken in the subsequent processes, may thus be obtained in a perfect state.

The mud remaining in the basin is then washed, a spoonful at a time, by placing it in a sieve of fine silk gauze, through which a gentle stream of water from the tap is kept running until all the fine particles have been removed. The muddy water should be allowed to settle in a bath, and the solid residuum then scraped out and thrown away. The sandy residuum left in the sieve should then be thoroughly dried, and is then ready for examination under the microscope, or if desired it may be further purified by the floating and rocking processes already described.

Foraminifera occur in marine fossil deposits of all geological ages, from the Cambrian to Post Tertiary deposits, but they are, as a rule, of sparing occurrence until we reach the Cretaceous period. The harder chalks and limestones can only be studied by means of thin sections, but the softer chalks, shales, and clays may be broken up by drying the material in small pieces, and washing it over a fine sieve in the manner just described. Floatings are seldom procurable from fossil deposits owing to the weight of the specimens, which are generally more or less infiltrated with pyrites or other mineral matter.

Some chalks and shales which resist the disintegrating action of water after being dried may be broken up by the action of a crystallising salt, which has been absorbed in a fluid state. Acetate of soda has the most rapid action, but very fair results may be obtained with common washing soda. The material after being broken up into small pellets is dropped into a boiling saturated solution of the salt, and kept at this temperature for a short time to allow of penetration. The salt is then allowed to cool, and in cooling crystallises, the formation of the crystals breaking up the outer layer of the material. On being warmed the soda dissolves again in its own water of crystallisation, and the crystallisation is repeated over and over again until the lumps are broken up. The resulting mud is then washed in the ordinary way.

The best Foraminifera from the chalk are those obtained from the interior cavities of hollow flints. They are often in the most perfect state of preservation, and the chalk in these cavities being of a powdery nature, they are very easily cleaned.

The cleaned material should be sifted into varying degrees of fineness, and each grade kept separately in a tightly corked tube, noted with locality, date, and any details as to the species contained in it, which may be likely to be useful for future purposes of reference. If the material has been properly cleaned and dried it can be kept unaltered for an indefinite period, but if put away damp, fungoid growth will quickly set in. This can be destroyed, and the material sterilised, by a prolonged soaking in spirit, the material being afterwards dried once more.

To examine the material under the microscope a picking-out tray will be necessary. This is made by covering a slip of card with coarse black ribbed silk, the ribs running longitudinally along the slip. A thin wooden ledge must be glued round three sides of the slip to prevent the Forams rolling off when the stage of the microscope is inclined at an angle. The material is sprinkled over the slip, and the ridges of silk keep the Forams from rolling about. The specimens required can then be easily selected by means of a fine sable brush, moistened by drawing it between the lips, and transferred to a prepared cell or slip.

The best fixative for mounting Foraminifera is gum tragacanth, which is almost invisible when dry, being quite devoid of the objectionable glaze which characterises gum arabic. It is also much less subject to variations of moisture than gum arabic, which alternately contracts and expands with changes of weather, and often fractures delicate forms. Powdered gum tragacanth should be used in the preparation of the mucilage. Put a small quantity of the powdered gum in a bottle with sufficient spirits of wine to just cover it. Add a small crystal of thymol or a few drops of clove oil, or oil of cassia, as an antiseptic, then fill the bottle with distilled water and set it by for some hours. The gum will form a thick mucilage, and may be used of varying thicknesses according to the size of the Foraminifera. For most forms it should be of about the consistency of cream, and it may be used liberally in mounting, as it shrinks very much in drying.

The same gum diluted to a watery consistency can be used as a fixative for Foraminifera mounted in balsam. If the slide is thoroughly dried before the balsam is added the gum becomes quite invisible.

For very large and heavy Foraminifera, seccotine or some other liquid glue may be used with advantage, gum not being of sufficient strength to hold them safely.

Many fossil Foraminifera and recent forms from some localities have the internal chambers filled with mineral infiltrations, either glauconite or pyrites. These internal casts reproduce more or less perfectly the shape of the sarcode body of the animal. They may be obtained by decalcifying the specimens with very dilute nitric acid,

XUM

just faintly acid to the taste. To obtain perfect casts the process must be carried out very slowly, adding drop by drop to the watch glass containing the specimen. When decalcification is complete, the resulting cast should be carefully removed with a pipette, and deposited in a spot of gum on a slip. They will not stand transference with a brush without damage.

NOTE.—*For particulars regarding the Distribution of Material, see below.*

Conducted by M. I. CROSS.

POND COLLECTING MONTH BY MONTH.—Mr. C. F. Rousselet has arranged to provide for each month a list of the material that should be looked for and likely to be found at that period of the year :—

POND-LIFE COLLECTING IN FEBRUARY.—In the early part of the year when the weather is still cold and ponds are covered with ice, some Infusoria may be found in abundance, particularly the various species of Vorticella—*Carchesium polypinum, Zoothamnium arbuscula, Epistylis flavicans*—attached to submerged rootlets.

Rotifera to be looked for in lakes and ponds, particularly duck ponds.—*Anuraea aculeata, Anuraea cochlearis, Asplanchna priodonta* and *Brightwelli, Notholca scappa, Polyarthra platyptera, Euchlanis deflexa, Synchaeta tremula.* The water plants having mostly died down, the following fixed forms are found attached on Anacharis or on submerged rootlets of plants, or of trees growing near the edge of ponds and lakes :—*Melicerta ringens, Limnias ceratophylli, Stephanoceros eichhornii, Floscularia cornuta* and others, *Oecistes crystallinus* and others.

TWO-SPEED FINE ADJUSTMENTS.—At first sight a proposition that a microscope should be provided with the equivalent of two fine adjustments, by means of which both an extremely slow and a rather more rapid movement might be imparted, in addition to a well-fitted coarse adjustment, would seem to be scarcely worthy of discussion. Consideration leads one to believe that it might occasionally be convenient, but actual working with the fitting itself puts the whole question beyond speculation.

Any mechanical contrivance which enables those who have to work rapidly to attain their results with increased facility is worthy of commendation, and its virtues should be made known.

An interesting paper by Mr. Ashe, with illustrations of the methods of application of two-speed fine adjustments, appears in the *Journal of the Quekett Microscopical Club* for November. Reichert, of Vienna, had already anticipated the idea by incorporating a similar arrangement in his large model microscope, but Mr. Ashe has rendered practical the fitting of the device to direct-acting screw fine adjustments of the Continental type, and, in conjunction with Messrs. R and J. Beck, has neatly contrived a manner of applying it to such instruments as have a fine adjustment, worked by a lever in the limb.

It consists of two concentric milled heads, working respectively coarse and fine screws, the former being controlled by the upper milled head, and at its point making contact with the lever. This operates through the lower milled head, which works on the fine thread, so that without real thought the fingers can move from one milled head to the other as a quick or slow motion may be required.

As a two-speed adjustment can be fitted to different classes of microscopes subsequent to manufacture, it is likely that many workers may feel disposed to have it experimentally added to their instruments.

INCREASING EFFECT WITH THE ABBE ILLUMINATOR.—The Abbe Illuminator has for some time been regarded as such an inferior condenser for all who aspire to accurate work, that little devices which might render it more efficient have been often overlooked. When the enormous number of them that are in use in all parts of the world is taken into consideration, every hint regarding them is of importance.

When the edge of the flame is focussed with an Abbe Illuminator and the back lens of the objective examined through the tube of the microscope, the black spots, which indicate the limit of aplanatism, appear when the iris is but slightly opened. If, however, the flat of the flame be used and carefully focussed, a much larger iris opening can be employed before the black spots appear ; in other words, the efficiency of the condenser can be very materially increased for critical illumination and a larger solid cone obtained by using the flat of the flame as the source of illumination instead of the edge.

FORAMINIFERA.—As notified in the January number, material is now at the disposal of readers of KNOWLEDGE who may wish to practise for themselves the directions given by Mr. Earland in his article on "Foraminifera." There are two kinds—(1) cleaned shore sand from Bognor, Sussex—"washings" or "floatings"—and (2) uncleaned dredged sand from shallow water, Barbados, West Indies. It is requested that applicants for this will enclose a stamped tie-on label addressed to themselves, and state which kind of material they wish for.

NOTES AND QUERIES.

W. A. F.—I have made inquiry with regard to the American Styrax Gum Liquidambar Styraciflua, and find that the liquidambar, which is the medium in which diatoms should be mounted, is almost unprocurable just now, and am told that one well-known diatom-mounter paid 50 francs for a few grammes of this medium. Grubler in his catalogue of re-agents, etc., includes Styrax solution in 10-gramme or 100-gramme tubes at a nominal price.

G. J. Maurice.—The subject of the causation of colorisation of hair is undoubtedly an interesting one, but I am not acquainted with any work which deals with the subject scientifically. You would probably find an opportunity for useful work if you dealt with this subject yourself.

J. F. Hewitt.—I have submitted the specimens and your notes to an expert on these matters, and his reply is as follows :—"My conclusion is that they are *Chloraster tetrarhynchus*, but they alter very much in form during their circle of life. The reproduction is by longitudinal fission, and at this time they develop the eight setase appendages preparatory to fission. I saw the creature on its side, and on the anterior end with the flagella equally separated and seeming to curve upwards. When on its side I saw at the anterior extremity two half-round projections ; these were (I think preparatory to fission) the rhynchi or beaks from whence issue the flagella."

Reader of "Knowledge."—In the January number a brief reply was inserted to this correspondent. He has since sent a fair quantity of material found growing in a water supply pipe. This has been examined by correspondents, who have identified it as belonging to the Polyzoa and to be *Paludicella Ehrenbergii.* There are no polypides, they have all died and disappeared, but there are winter buds.

Three other correspondents have sent letters with regard to Paludicella.

One mentions that Prof. Allman's fine Monograph of the British Fresh-water Polyzoa (Ray Society's Publication, 1856-1857) is *the* work to be consulted. Prof. E. Ray Lankester, in the 9th edition of the "Encyclopædia Britannica," examines in some detail *Paludicella Ehrenbergii*, which he takes as a type for comparison with the other groups of the Polyzoan class. The fresh-water groups of the class are also the subject of a Monograph by M. J. Jullien in the *Bull. Soc. Zool. de France, Xth.* Further, he points out that "the growths and organisms which establish themselves in the numerous systems of conduits, mains, and other closed channels existing in the kingdom, and used to convey waters of very great variety analytically, derived from sources differing from the superficial to the deeply subterranean, and delivered under a hundred or two of conditions which tend to foster vegetative or animal life, or both, would form a subject for a very extensive Monograph of their own."

The other correspondent gives the following information :—"Paludicella is a fresh-water genus of the class 'Bryozoa' (Polyzoa), sub-class Ectoprocta, order Gymnolaema, sub-order

Ctenostoma. It has a circular disc of tentacles, which are free and of one row only. Johnston's 'British Zoophytes' is the classical work on the 'Hydroida' and 'Molluscoida,' but if the inquirer refers to Vol. 6, p. 420, of the 'Royal Nat. History,' he will find an account of 'Paludicella,' together with a sectional woodcut of an individual animal."

Correspondents who have assisted in this matter have taken a considerable amount of interest in it, and one in particular has expressed a wish to have further material of a similar character sent to him for investigation from time to time.

A. H. Glaister.—There is no special advantage to be derived from the use of a low-power objective instead of an eyepiece, but if you wish to experiment further, you will find that you will do best by inverting the objective used as an eyepiece, so that the light passes through it the reverse way, that is from the back lens to the front lens. The field will then be equal to the angle of the objective. The trouble attributed to the Abbe condenser is in all probability due to the objectives which are visually corrected, and therefore photographically over-corrected. Racking the condenser high up has the same effect as shutting the diaphragm, that is, it utilizes the under-corrected central zone of the objective and thus produces a better photographic effect. A light filter, such as the acetate of copper solution referred to in KNOWLEDGE, February, 1901, or a Gifford's Screen, would probably be found advantageous.

Consultants.—An increasing number of correspondents send material and specimens for identification and naming. It would be of great assistance if readers who feel able to do so would co-operate and act as honorary consultants in these matters. I shall be glad to hear from such as are willing to assist, with particulars of the subject they are competent to deal with.

Communications and enquiries on Microscopical matters are cordially invited, and should be addressed to M. I. CROSS, KNOWLEDGE *Office*, 326, *High Holborn*, *W.C.*

NOTES ON COMETS AND METEORS.

By W. F. DENNING, F.R.A.S.

COMET 1900 II. (BORRELLY-BROOKS).—In *Ast. Nach.* 3753, Mr. J. M. Poor, of Princeton Observatory, N.Y., asks for unpublished observations of this comet, as he intends to compute a definitive orbit for it. The comet was independently discovered on July 23rd, 1900, by M. Borrelly at Marseilles, and by Mr. Brooks at Geneva, U.S.A., the former having priority by about five hours. The object was fairly bright, with a conspicuous tail about one degree in length, and there were two auxiliary tails or faint off-shoots from the main ray. The comet became very feeble at the end of September, and parabolic elements apparently satisfied the observations.

ENCKE'S COMET.—Though the position of this comet was by no means favourable at his recent return, some excellent observations were obtained at various European stations in the mornings of August and September. In *Ast. Nach.* 3757, Herr H. Struve, of Königsberg, gives the results of measures obtained on thirteen nights between August 8th and September 4th, 1901, inclusive. Sig. A. Abetti, of Arcetri-Firenze, also gives the positions on ten nights between August 9th and 23rd. On August 9th the comet appeared as a faint nebulosity, without a nucleus, and about one minute of arc in diameter.

FIREBALL OF DECEMBER 4TH.—The writer has collected and compared 62 accounts of this brilliant object, but the observations are far from being satisfactory. The real path deduced from them is therefore a little uncertain, so that the exact height of the fireball at its first appearance and final disruption cannot be stated with confidence. But there is no doubt that the approximate elevation was from about 91 to 50 miles over the English Channel, a few miles off the coast of Dorset, and that the direction was from W. to E., with a slight southerly inclination. The streak of the meteor was from 72 to 55 miles high, and 26 miles in length. Several correspondents refer to a hissing or rushing noise which accompanied the flight of the object, while others say that its passage through the air was performed in absolute silence. The great majority of the observers heard nothing, and it is obvious that any detonation proceeding from the disruption of the fireball could not have been heard until several minutes after the phenomenon had disappeared. In describing the fireball of September 14th last, brilliantly visible over South Wales, several of the spectators stated that they distinctly heard a hissing sound simultaneously with the meteor's descent. This is, in fact, a common feature of such observations, but there is no doubt that the impression is an erroneous one. The rushing noise which accompanies the flight of a rocket is familiar to everyone's ears, and amid the surprise occasioned by the sudden apparition of a brilliant rocket-like meteor, the imagination is naturally incited to receive a similar sensation.

FIREBALL OF DECEMBER 16TH.—In the early evening, at 5h. 45m., a brilliant meteor was witnessed by Mr. W. E. Besley at London, by Mr. Johnson at Bridport, and by an observer at Yeovil. At Bridport the object was estimated to be as bright as the moon in her quarters. It moved slowly and vanished near Venus. As seen from Yeovil, the meteor descended in a path parallel with the moon and Venus, and somewhat east of them. The object was probably a late Geminid, moving from N.E. to S.W. over the English Channel, west of Guernsey, and falling from 68 to 54 miles. The length of path was approximately 51 miles, and velocity 20 miles per second, but these results are somewhat uncertain, and it would be useful to hear of further observations.

FIREBALL OF DECEMBER 19TH.—At about 0.45 a.m. on this date a very large meteor was seen in the north of England, but it appears to have been very inadequately observed. Police-Constable Clarke, of Haworth, writes to the *Scarborough Mercury* that he saw a bright light, and on looking up noticed a very large body of some kind travelling along at about the height of an ordinary mill chimney. The object was about as big as the largest ship he had ever seen. It travelled from E. to W., and it went out in the neighbourhood of the seven stars (Pleiades). It was visible for 14 minutes, and left a tail behind it.

THE FACE OF THE SKY FOR FEBRUARY.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the sun rises at 7.42 A.M., and sets at 4.46 P.M. On the 28th he rises at 6.52 A.M., and sets at 5.35 P.M. The sun appears to be in a very quiescent state, and there is quite a dearth of spots.

Towards the end of the month the Zodiacal Light may be looked for in the west shortly after sunset.

THE MOON:—

	Phases.	h. m.
Feb. 8	● New Moon	1 22 P.M.
„ 15	☽ First quarter	2 57 P.M.
„ 22	○ Full Moon	1 3 P.M.

The more interesting occultations visible at Greenwich are as indicated in the following table:—

Date.	Name.	Magnitude.	Disappearance.			Reappearance.			Moon's Age.
			Mean Time.	Angle from N. Point.	Angle from Vertex.	Mean Time.	Angle from N. Point.	Angle from Vertex.	
				°	°		°	°	d. h.
Feb. 12	ϵ Piscium	4·5	7 40 P.M.	124	87	8 18 P.M.	201	162	4 6
„ 14	σ Arietis	5·5	5 53 P.M.	121	110	6 45 P.M.	210	188	6 4
„ 15	B.A.C. 1240	5·7	11 27 P.M.	22	341	11 52 P.M.	333	292	7 10
„ 16	i Tauri	5·1	6 24 P.M.	130	140	7 18 P.M.	222	217	8 5
„ 20	A^2 Cancri	5·8	6 13 P.M.	116	155	7 16 P.M.	272	307	12 5
„ 20	60 Cancri	5·7	11 16 P.M.	70	64	0 11 A.M.	334	315	12 10

THE PLANETS.—Mercury is an evening star, and has an easterly elongation of 18° 17′ on the 3rd. About this time the planet will be favourably situated for observation, as he remains about 1h. 45m. above the horizon, after the sun has set. The path of the planet lies in Aquarius and makes a loop around the fourth magnitude star θ Aquarii. On the 2nd of the month it has the same R.A. as the star, but is $2\frac{1}{2}$° to the south, its motion being easterly, and on the 16th it again has the same right ascension as the star, but is 1° to the north, its motion being westerly, bringing it into inferior conjunction with the sun on the 18th.

Venus, also in Aquarius, is an evening star for a few days in the earlier part of the month, but its rapid retrograde motion brings it into inferior conjunction with the sun on the 14th. On the 1st of the month it sets about

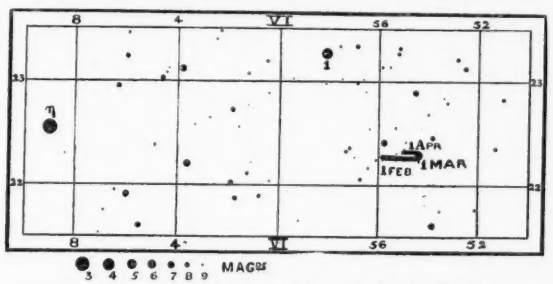
7 P.M., or more than two hours after the sun; about this time the planet presents a large crescent of nearly 1′ diameter to a telescopic view.

Mars is also in Aquarius, but sets shortly after the sun, and is therefore not suitable for observation.

Jupiter and Saturn are in Sagittarius, but as they rise only about an hour before the sun, they are inconvenient for observing purposes.

Uranus is in the most southerly part of Ophiuchus near the stars θ and ξ Ophiuchi, and rises a little more than three hours before the sun; its great southerly declination, however, makes it somewhat unsuitable for observation.

Neptune is favourably situated throughout the month. He crosses the meridian at 9.11 P.M. on the 1st, and at 7.23 P.M on the 28th. The planet is still on the borders of Gemini and Taurus, not very distant from 1 Geminorum. The accompanying chart should enable it to be



Path of Neptune from 1st February to 1st April, 1902.

found readily. The chart shows all the stars down to the 8·5 magnitude, which lay near the planet's track. The planet appears in the telescope as a star a little brighter than the 8th magnitude, the colour is said to be greenish, but this is not very noticeable in small telescopes.

THE STARS.—The positions of the principal constellations about 9 P.M. at the middle of the month are as follow:—

ZENITH . Auriga (brightest star *Capella*), is a little west of the zenith.

SOUTH . Gemini (*Castor* and *Pollux*) high up, *Procyon* and *Sirius*; Orion is a little west of the meridian, Taurus is to south-west, high up, Cancer and Hydra to the south-east.

EAST . Leo (*Regulus*) a little south of east, Virgo low down, to the north-east Ursa Major, *Arcturus* rising.

WEST . Perseus, Pleiades, Pisces and Aries with Cygnus to the north-west, and Cetus to the south-west.

NORTH . Cassiopeia, Cepheus, Draco and Ursa Minor, with *Vega* on the horizon.

Minima of Algol occur at convenient times on the 17th at 11.43 P.M., and on the 20th at 8.32 P.M.

Chess Column.

By C. D. LOCOCK, B.A.

Communications for this column should be addressed to C. D. LOCOCK, Netherfield, Camberley, and be posted by the 10th of each month.

Solutions of January Problems.

No. 1.

(S. G. Luckcock.)

1. Kt × P, and mates next move.

No. 2.

(C. D. Locock and J. K. Macmeikan.)

Main Solution.

Key-move.—1. B to B4.

If 1. . . . P to R7, 2. R × QKtP, etc.
1. . . . P × B, 2. R to QB5, etc.
1. . . . P to K4, 2. R to KB5, etc.

[A second solution by 1. R to K5 was intentionally left, partly because it could hardly be avoided, while a third by 1. R to Kt4, was left accidentally, the authors erroneously supposing that 1. . . P to K4 would be a valid defence. The main idea of the problem, in fact the primary object in view, was the "try" by 1. Kt to Kt6, P to R7; 2. Kt × P at Q2 (or Kt to QB4), P to R8 (becoming a Bishop); 3 Kt to K5, stalemate. We print below, in case it may be of interest, an earlier, and in some respects superior version of the problem, which the authors believe to be sound, though it was rejected as not being so suitable to the special purpose in view as the unsound version given last month.]

Mr. W. Nash was credited with a point too few last month. He should accordingly have been bracketed ninth, with a score of 64.

CORRECT SOLUTIONS of No. 1 received from J. Baddeley, Alpha, W. Nash, W. de P. Crousaz, W. V. M. Popham, G. W. Middleton, W. Jay, G. Woodcock, H. Le Jeune, F. Dennis, W. H. Boyes, C. Johnston, C. R. Beechey, E. F. B. Barlow, H. H. S. (Teddington), A. C. Challenger.

Of No. 2 from W. Jay (2 solutions), Alpha, S. G. Luckcock, W. Nash (2 solutions), W. de P Crousaz (3 correct, 1 incorrect), W. V. M. Popham, G. W. Middleton (1 correct, 1 incorrect), W. H. Boyes, C. Johnston (3 correct, 1 incorrect), C. R. Beechey (1 correct, 1 incorrect), H. H. S. (Teddington), A. C. Challenger, four of whom, besides seven others, have duly fallen into the "stalemate trap." Mr. Luckcock alone has commented on the trap, though of course others may have seen through it.

Several correspondents.—Many thanks for your good wishes.

Balham.—[I cannot find your signature.] In No. 1, R to Bsq. is answered by Kt × R or Kt to B3. In No. 2, after 1. B × RP, P to R7; 2. R × QKtP, P Queens; 3. R to QKt8, Q to B6 (or 8), there is no mate. The Bishop must go to B4, in order to nullify the effect of Black's third move.

C. R. Beechey.—Your claim for duals in No. 1, after three moves of the Black Knight, is quite correct.

G. Woodcock.—After 1. R to KKt2, P to R7; 2. R (Ktsq) × P, P Queens, 3. R to Kt8, Black replies Q to B6 (or 8).

G. W. Middleton.—Have written to the publishers accordingly. Congratulations on your other success.

W. Nash.—I regret the mistake, which I had suspected, but was unable to verify. The fact that I had destroyed your card made me suspect that I had credited you with a point too little, as it is my practice to destroy only those solutions which score full points.

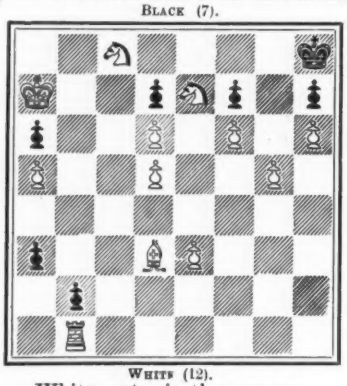
E. F. B. Barlow.—Thanks for the problem, which shall appear shortly if found apparently sound. Could you not find a less *strong* key? Your particular method of printing is new to me, though rubber stamps are of course constantly used for printing the pieces.

A. C. Challenger.—Have noted your preference as to date.

REPRINTED PROBLEM.

By C. D. Locock and J. K. Macmeikan.

BLACK (7).



WHITE (12).

White mates in three moves.

Solution.

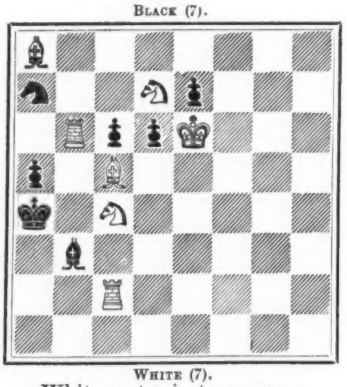
1. B to B4, P to R7.
2. R × P, P Queens.
3. R to Kt8 Q moves.
4. Kt to Kt6 mate.

PROBLEMS.

By P. H. Williams.

No. 1.

BLACK (7).

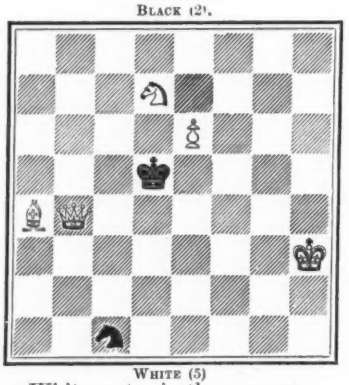


WHITE (7).

White mates in two moves.

No. 2.

BLACK (2).



WHITE (5)

White mates in three moves.

CONCLUSION OF SOLUTION TOURNEY.

The tie for first and second prizes between Messrs. Jay and Johnston has been decided by means of the four-move problem in the January number, and a special three-move problem (with two solutions) sent to them by post. The result was that Mr. Johnston sent both keys (B to Ksq and B to R3) to the three-mover, and three correct keys (besides Kt to Kt6, incorrect) to the four-mover, scoring therefore 15—2=13 points. Mr. Jay sent only B to R3 (the cook) for the three-mover, and two keys (B to B4 and R to K5) for the four-mover, scoring 9 points. After an exceedingly close struggle, Mr. Johnston accordingly wins the first prize of one guinea, Mr. Jay obtaining the second prize, consisting of twelve months' subscription to KNOWLEDGE. The award, as usual, remains open for one month.

Owing to want of space, and the fact that details of the Challenge Trophy have not yet reached me, the publication of conditions of the next Solution Tourney is postponed till next month.

CHESS INTELLIGENCE.

British Chess Magazine.—Three-move Problem Tourney. Competitors are reminded that entries for this event, for which valuable prizes have been presented by Sir J. O. S. Thursby, close, for European competitors, on January 31st. Entries, with motto, sealed name and address, etc., should be sent to the Problem Editor, 21, Nelson Road, Stroud Green, London, N. Dr. C. Planck and Mr. C. D. Locock have been appointed judges.

The New Century Chess-Book (Sampson Low, Marston & Co.) is the title of Mr. James Mortimer's supplementary continuation of his well-known *Chess Player's Pocket Book*. Its contents comprise all the most modern lines of play in the various openings, special prominence being given to the Rice Gambit, which has the distinction of being the only opening in which a piece may be sacrificed early without obtaining a demonstrably lost game. The price of the book is 1s., and there is no reason why it should not become as popular as its predecessor.

The "Elsie" Chess-Board and Men (British Chess Company, Stroud, Gloucester) is made in three sizes, 8 × 6, $9\frac{1}{2} \times 7$, and $10\frac{1}{4} \times 7\frac{3}{4}$ inches, the prices being respectively 4s., 4s. 6d. and 5s. The board is of stout varnished millboard, fixed into a covered cardboard box, with holes for the pegged men, whether in play or captured. The chess men are of wood and of a good pattern. Altogether, this is certainly the simplest and quite one of the best of *in statu quo* boards.

The latest edition of Mr. Rhodes Marriott's *Chess-Players' Note-Book* (Sherratt & Hughes, Manchester) is certainly very cheap at 1s. It contains 165 pages, bound in cloth, every page being perforated for detachment. Part I. consists of 20 diagrams, the reverse sides being used for recording games or solutions. The bulk of the remainder consists of game-recorders, with letter-forms to Chess-Editors, a summary of the results of games, and space for newspaper cuttings. Mr. Edwyn Anthony's *Notes on the Opposition* are also included.

All manuscripts should be addressed to the Editors of KNOWLEDGE, 326, High Holborn, London; they should be easily legible or typewritten. All diagrams or drawings intended for reproduction, should be made in a good black medium on white card. While happy to consider unsolicited contributions, which should be accompanied by a stamped and addressed envelope, the Editors cannot be responsible for the loss of any MS. submitted, or for delay in its return, although every care will be taken of those sent.

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